# DOCUMENT RESUME

ED 143 146 EA 009 903

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|---|---|
| AUTHOR | Brewster, Sam F. |
| TITLE | Campus Planning and Construction: Physical Facilities for Universities and Colleges. |
| INSTITUTION | Association of Physical Plant Administrators of Universities and Colleges, Washington, D.C. |
| PUB DATE | 76 |
| NOTE | 395p.; Photographs, charts, and Appendix C may not reproduce clearly |
| AVAILABLE FROM | Association of Physical Plant Administrators of Universities and Colleges, Suite 525, One Dupont Circle, Wahington, D.C. 20036 ($15.00 postpaid; Add $1.00 per order if you wish to be billed) |
| EDRS PRICE | MF-$0.83 Plus Postage. HC Not Available from EDRS. |
| DESCRIPTORS | Administrative Organization; Administrative Personnel; *Architectural Programing; Bids; *Campus Planning; *College Planning; Construction Costs; Facility Case Studies; Facility Guidelines; *Facility Planning; Facility Requirements; Higher Education; Master Plans; *School Construction; School Maintenance |

ABSTRACT

The important phases of planning and constructing physical facilities for universities and colleges are brought together so that persons responsible for providing these facilities can readily evaluate their present policies and organizations. The subject is addressed from the point of view of the professional physical plant administrator. The text is a comprehensive treatment of methods that have been used successfully in the development of campuses, and it has application to other types of public projects as well as to profit-oriented facilities. Stressing not only what is needed, but also the whys and how, it is a guide for any planning and construction project. The appendixes contain (1) responses from 42 universities and colleges that contributed information on planning and construction; (2) brief case histories of seven universities and colleges; and (3) examples of forms, contracts, and agreements developed by planning and construction offices in these institutitons. A list of selected references and a subject index complete the book. (Author/MLF)

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# Campus Planning and Construction

## Physical Facilities for Universities and Colleges

Sam F. Brewster

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The Association of Physical Plant Administrators
of Universities and Colleges

EA 009 903

Dedicated

to

Friends and Colleagues

—Past and Present—

of the

Association of Physical Plant Administrators

of

Universities and Colleges

Library of Congress Catalog Card Number: 76-53135
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The Association of Physical Plant Administrators of Universities
and Colleges, Suite 525, One Dupont Circle, Washington, D.C. 20036
Printed in the United States of America by Brigham Young University
Printing Service

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# Foreword

The opportunity to grasp and record a lifetime of distinguished professional knowledge occurs all too infrequently. This book accomplishes that mission through the combined efforts of its author, Sam F. Brewster, and the Association of Physical Plant Administrators of Universities and Colleges.

Much has already been written on planning and construction. But this book is unique in that it addresses the subject from the point of view of the professional physical plant administrator, the man who directs not only the programming, planning, and construction of university and college physical facilities, but also the long-range maintenance and operation of these facilities. "To live with it is to know it."

The text is a comprehensive treatment of methods that have been used successfully in the development of campuses, and it has application to other types of public projects as well as to profit-oriented facilities. Stressing not only what is needed, but also the whys and hows, it is a valuable guide for any planning and construction project.

Sam F. Brewster, one of the patriarchs of his profession and professional association (Association of Physical Plant Administrators of Universities and Colleges) brings many years of service and experience to bear in compiling this text. A graduate of Texas A. and M. University in 1927 with a major in landscape architecture, he acquired additional formal education at the University of Massachusetts, in England, and at the Harvard University Summer

School in 1929. In 1932 he received the Master of Landscape Architecture (M.L.A.) degree from the University of Massachusetts.

Mr. Brewster became director of Buildings and Grounds at Auburn University in 1940 and served there until he became the director of Physical Plant at Brigham Young University in the fall of 1957, the position he held until his retirement in the fall of 1974. He was responsible for planning, construction, and maintenance and operation of the physical facilities at both schools. As a fitting reward for seventeen years of distinguished service to Brigham Young University, that institution awarded him an Honorary Doctor of Public Service Degree in 1970 and, upon his retirement, named the Physical Plant Building after him.

He was president of the Association of Physical Plant Administrators of Universities and Colleges in 1954, and he was the recipient of its Meritorious Service Award in 1958. He has been a member of other professional and civic associations and has received numerous recognitions. He has written extensively in his professional field and other areas of interest.

Mr. Brewster has blended his encyclopedic knowledge with a practical approach to provide a succinct explanation of the planning and construction processes involved in developing the physical facilities of universities and colleges.

This book complements an earlier APPA publication, *A Basic Manual for Physical Plant Administrators*, by George O. Weber (1974), and should be included in the library of anyone even remotely interested in facilities planning and construction.

# Preface

Many billions of dollars have been spent in constructing physical facilities for universities and colleges. And planning and construction will continue—perhaps not at the accelerated speed of the past two or three decades, but in substantial amounts. Much good work has been done, but some leaves much to be desired.

This book covers the important phases of planning and construction and some closely related subjects. There is nothing theoretical. Every contributor is, or has been, a successful Physical Plant administrator or a professional full-time architect, engineer, or landscape architect engaged in the development of campus physical facilities. Each private architect and engineer who critiqued portions of the book has had years of outstanding success in developing physical facilities at a number of universities and colleges.

Significant writing has been done on the subjects covered in this book. However, most of that writing deals separately with either planning or construction. Furthermore, these writings are contained in a few specialized books and numerous papers, magazine articles, minutes of meetings, and other short published articles. Thus, information on the subject of how to organize a complete program for physical plant development requires much research. This book brings together many of those concepts and considerations so that persons responsible for providing physical facilities can readily evaluate their present policies and organizations and, hopefully, provide better facilities in the future with less effort and perhaps at more reasonable cost.

There are poor, good, and better ways to plan and build. Considering the ever-increasing cost of construction, maintenance, and operation, it is time that the poor and good methods be discarded and better methods and procedures adopted. No one system, no matter how well it works at one school, will be totally adaptable at all schools. Thus, this book discusses a variety of methods so that comparisons and choices may be made. The reader is urged to keep an open mind. His program may be satisfactory to everyone connected with his school, but a study of what is being done at other institutions may suggest even better ways.

S.F.B.
Provo, Utah
1976

# Acknowledgments

Many individuals have helped to make this publication possible by giving generously of their time and knowledge, and I gratefully acknowledge their wholehearted support and cooperation.

I express my sincere thanks to those persons who completed a long and detailed questionnaire on planning and construction, and who gave their permission to be quoted. A casual reading of the book will disclose the names and titles of many of these contributors.

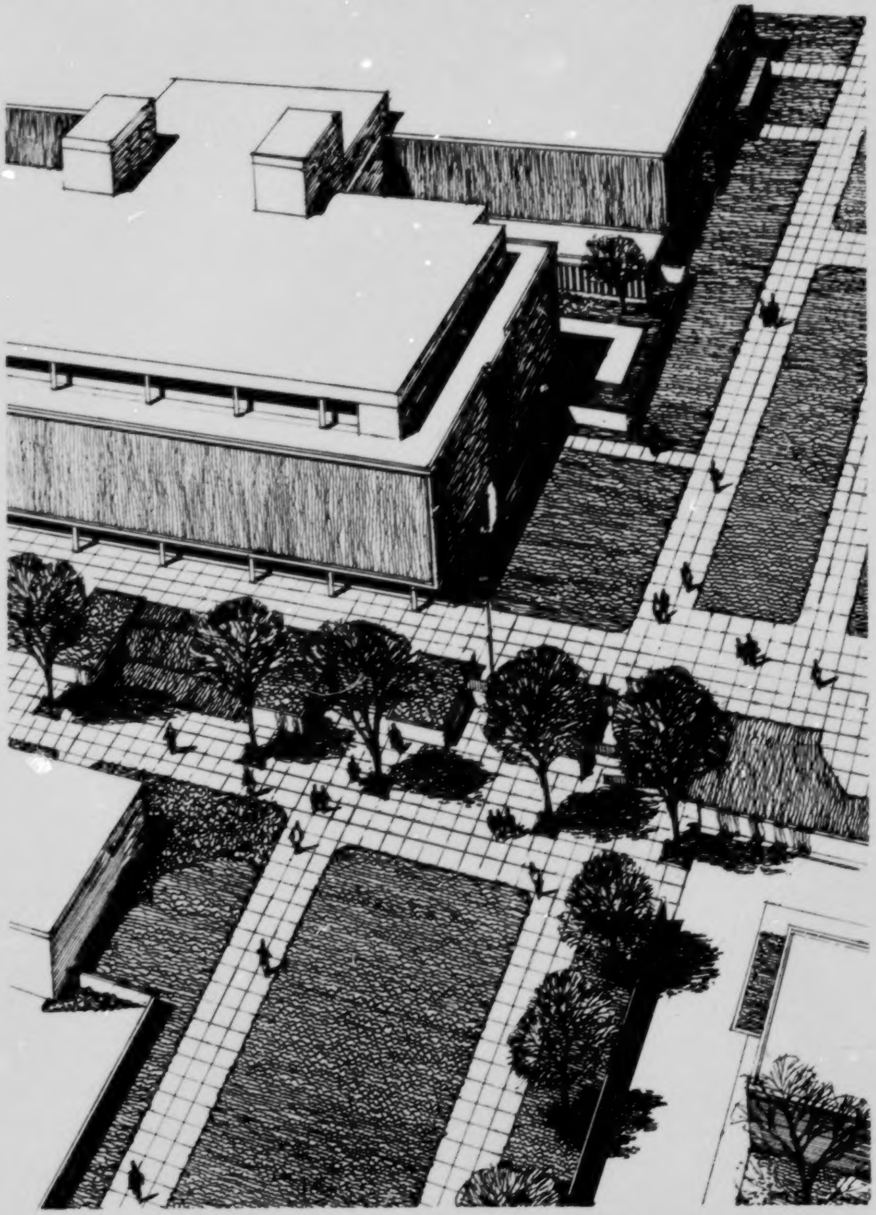
Acknowledgment is made of the cooperation of members of the Association of Physical Plant Administrators of Universities and Colleges, and of the planning officials of many schools. The material and information they supplied was so generous that the main problem was one of selection.

Special recognition is made of the great assistance of Brigham Young University staff: Ben E. Lewis, Executive Vice-President; Fred A. Schwendiman, Assistant Vice-President for Physical Plant; Harold J. Anderson, Assistant Director of Physical Plant; Paul G. Rasmussen, Construction Engineer, Physical Plant; and the many staff members in Physical Plant who provided assistance in so many ways; Ernest L. Olson, Director, University Press; John N. Drayton, Acquisitions Editor, Editorial Department; George L. Hampton, Manager, Photo Studio, William D. Farnsworth, Administrator of Media Services.

A special word of thanks to the following, all of whom supplied invaluable professional information and some of whom also read and critiqued certain chapters: Robert A. Fowler, A.I.A.; Fred L. Markham, F.A.I.A.; Frank H. Bridgers, Mechanical Engineer; Ralph L. Rollins, Civil Engineer; Carr F. Greer, Civil Engineer; A. A. Van Teylingen, Director, Facilities Planning, Montana State University; Don S. Domgaard, President, Management Consulting and Information Systems; Robert P. Kelleher, Administrator, Department of Physical Plant, University of California, Davis; and Maurice X. Pia, Vice-President, Olympus Aerial Surveys, Inc.

The following were helpful at all stages, and each read and critiqued the entire manuscript: Harry F. Ebert, President (1976-77) of the Association of Physical Plant Administrators of Universities and Colleges; Peter P. Welanetz, Immediate Past President of APPA; Gene B. Cross, President Elect of APPA; and Paul T. Knapp, Executive Director of APPA. Their interest and support is gratefully acknowledged.

# Part 1: Planning



# 1

# Organizing for Developing Physical Facilities

## School Administration

The telephone rang, and the long-distance operator announced that the president of a major state university was calling. His first words were, "I've been told that you can help me. Our school has received a sizable appropriation for a building program, but we're at a loss on how to get started. Can you advise us?" Why would the president make this appeal personally?

Another university president gave one answer: "I think the breakdown in my health came because I couldn't keep our building program moving fast enough to stay ahead of the students clamoring for admission." Physical Plant development is a top-level administrative challenge.

True, both events happened several years ago. And since then most universities have solved or partially solved their planning and construction problems. However, planning and Physical Plant consultants are still in demand. This would seem to indicate that there are still administrative problems connected with the Physical Plant at many schools.

Certainly there does not appear to be any uniform way of administering a program for developing physical facilities. A quick glance at Appendix A will indicate the numerous variations found in just forty-two institutions of higher education. "An examination of existing organization charts is not likely to produce one acceptable for copy and application to a second situation. Neither does it disclose anything approaching a standard."[1]

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[1] Harry F. Ebert, Director of Physical Plant, Rice University, "Physical Plant Organizations in Universities and Colleges," *Technical Papers of the Association of Physical*

> *After having studied and analyzed 109 returned questionnaires and fifty-nine organization charts, I am of the opinion that the only thing consistent about Physical Plant organizations is their inconsistency. Of the fifty-nine charts submitted, no two were alike; and I suspect that the same would be true if the organizational charts of every educational institution in the country were compared. There is, however, a remarkable similarity even when comparing the smaller schools with the larger schools in the jobs that are being done. The differences are largely in how the departments are organized to accomplish their work. That, plus the fact that some schools seem more inclined than others to split the various planning, construction, and operation and maintenance activities among different departments rather than assemble them or most of them in one department.*[2]

It would be next to impossible to tailor the perfect organization for all schools. There are too many variables. There are private schools, public schools, church-related schools, medical schools, municipal schools, community schools, large and small schools, and some better off financially than others. A program that would work really well at one university or college might be completely out of scale and even impossible at another. Federal, state, and municipal agencies enact laws, rules, and policies that to a greater or lesser extent affect the administrative organization at some schools.

Furthermore, employees with tenure or long years of service must be considered in organizing or reorganizing departments or major functions such as those dealing with physical facilities. In fact, finding a place for such employees will often determine the ultimate form the organization chart will take. M. F. Fifield, former director of Physical Plant at the University of New Mexico, stated it this way: "No matter how intelligently and carefully you plan your organization, it's not going to work quite that way because of the people in it." One smart man, identity unknown, said he could handle the professional and technical problems all right; it was the people problems that "bugged" him. Finding a place for everyone may be commendable, but a strong and productive organization is developed around people who are well qualified and adjusted to their positions. This is especially true in physical facilities planning and construction. Almost without exception the people responsible for those functions should be professionals or specialists. Permanent personnel should certainly be selected on the basis of their training,

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*Plant Administrators of Universities and Colleges*, Association of Physical Plant Administrators of Universities and Colleges, 1976.

[2] Sam F. Brewster, Director of Physical Plant (retired), Brigham Young University, "Organizations and Functions of Physical Plant Departments of Universities and Colleges," Minutes of the Forty-Sixth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Kansas State University, 1959.

experience, and ability to do outstanding work. Similarly, no political architect or engineer should be given preference for a college or university project—unless his professional qualifications are at least as good as those of the other architects and engineers equally interested in doing the project. Modern school buildings are highly complex structures costing millions of dollars to build and more millions to keep operational. Organization charts for facilities development and operation will not be worth the paper they are drawn on unless the positions provided for are filled with productive people and not with people problems.

Even at the highest levels, there are differences that can affect the organization or organizations responsible for planning and construction. Fairly often the board of trustees or regents will have a building committee. And occasionally the chairman or some committee member will be so intensely interested in the routine affairs of planning and construction that he will cause administrative problems. Such a man is motivated by a deep love for the school and a sincere desire to see its programs succeed. Generally he is a real "doer" who wants to be right in the heart of the action. But it is possible that by so doing he will create more problems than he can solve.

A top school administrator can be affected the same way. He would rather work with architects, engineers, and contractors than attend a meeting of the deans' council. However, his multitudinous duties prevent him from working at it full time, so he dips in and out of the routine operation of the responsible department. The result: administrative problems.

Another chief school administrator might be just the opposite. He would be so faculty-oriented that he would leave all or most administration of physical affairs to someone of lesser rank. This will work fairly well in most cases, but there are exceptions. The person in charge of a major building program should have direct contact with the president or chancellor. Many decisions are so important that they can be made only by the president, and often even he cannot make some decisions before consulting with his board of trustees. It is much more productive if the man with the questions can deal directly with the *only* person in a position to answer the questions: "The responsibility for planning rests naturally with the chief administrative officer—and any delegation of authority by him to be effective must remain at a high echelon level. This is to say the chief planning officer should advise the president directly rather than through a series of administrative heads which negate or divert needed planning action."[3] There seems little doubt that a 30-minute to one-hour conference once a week between the president and his planning official can keep building programs on schedule almost more than anything else. A physical facilities program must be geared to the academic needs of the school, and academic personnel should be involved at proper stages. However, it is doubtful that academic personnel at any level should become so involved in planning and construction affairs that they make administrative decisions that should be made only by the President, executive vice-president, financial vice-president, business manager, or director of Physical Plant.

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[3] Clyde Robbins, Campus Planner and Assistant Professor of Planning, Georgia Institute of Technology, "Campus Planning," Paper given at the Seventeenth Annual Meeting of the Southeastern Regional Association of the Association of Physical Plant Administrators of Universities and Colleges, Georgia Institute of Technology, 1968.

A study of the construction questionnaire in Appendix A will indicate how certain departments are organized to administer planning and construction. Methods seem to fall into three major patterns: (1) The combination of planning, construction, and maintenance and operation in the Department of Physical Plant or in the Buildings and Grounds Department, (2) The combination of planning and construction in a department other than the Department of Physical Plant, and (3) Schools with separate planning offices but with construction as a responsibility of the Department of Physical Plant. It would appear from the limited sampling done that a large majority

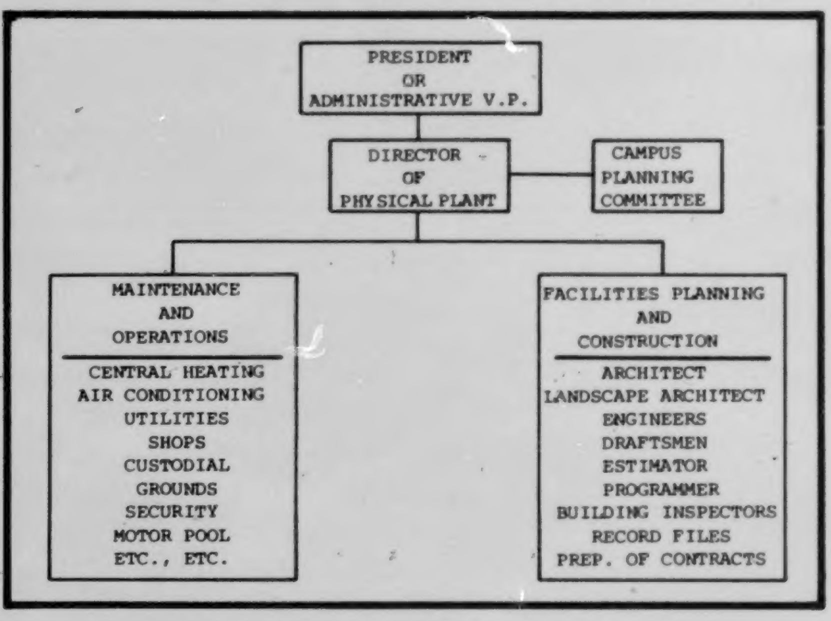
PRESIDENT
OR
ADMINISTRATIVE V.P.
DIRECTOR
OF
PHYSICAL PLANT
CAMPUS
PLANNING
COMMITTEE
MAINTENANCE
AND
OPERATIONS
CENTRAL HEATING
AIR CONDITIONING
UTILITIES
SHOPS
CUSTODIAL
GROUNDS
SECURITY
MOTOR POOL
ETC., ETC.
FACILITIES PLANNING
AND
CONSTRUCTION
ARCHITECT
LANDSCAPE ARCHITECT
ENGINEERS
DRAFTSMEN
ESTIMATOR
PROGRAMMER
BUILDING INSPECTORS
RECORD FILES
PREP. OF CONTRACTS

Chart 1. This type of organization has much to recommend it, especially for a school with a sizable building program. The director coordinates planning, construction, and maintenance and operations. He is in the right position to use all physical facilities personnel where and when they are needed. The director occupies a key administrative position, and, if properly qualified, can insure that the school's total physical facilities program will be well cared for.

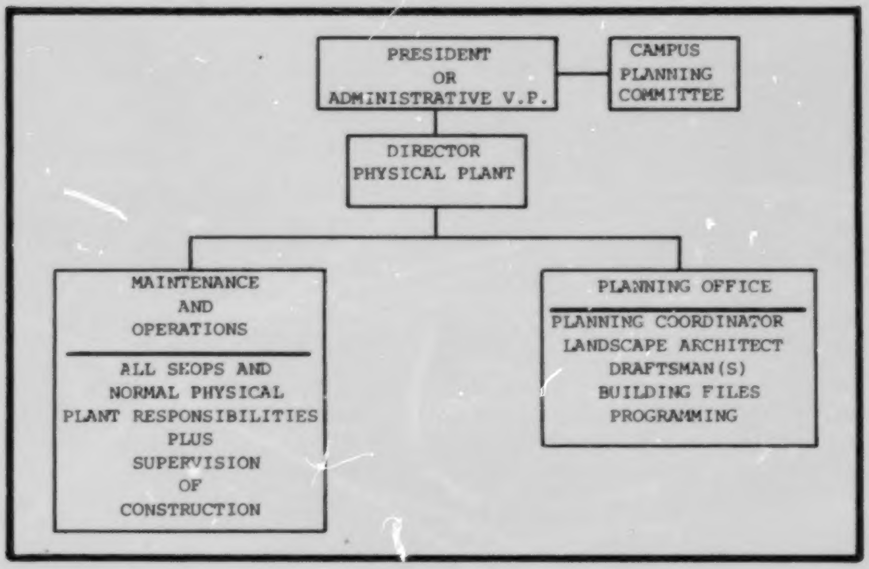
PRESIDENT
OR
ADMINISTRATIVE V.P.
CAMPUS
PLANNING
COMMITTEE
DIRECTOR
PHYSICAL PLANT
MAINTENANCE
AND
OPERATIONS
ALL SHOPS AND
NORMAL PHYSICAL
PLANT RESPONSIBILITIES
PLUS
SUPERVISION
OF
CONSTRUCTION
PLANNING OFFICE
PLANNING COORDINATOR
LANDSCAPE ARCHITECT
DRAFTSMAN(S)
BUILDING FILES
PROGRAMMING

Chart 2. This would be a good organization for a school with fewer planning and construction projects. The director would be responsible for coordinating all physical facilities personnel and work. Responsibility for construction is in maintenance and operations, where the skilled mechanics of several crafts can be best utilized. It has most of the advantages of the organization in chart 1.

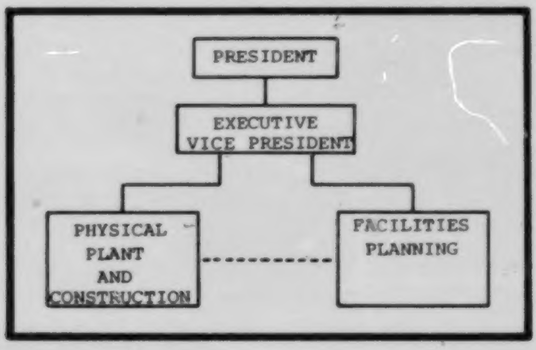
PRESIDENT
EXECUTIVE
VICE PRESIDENT
PHYSICAL
PLANT
AND
CONSTRUCTION
FACILITIES
PLANNING

Chart 3. In this type of organization the vice-president becomes the coordinator between facilities planning and physical plant and construction. It is likely that he was employed for his knowledge and experience in some other phase of university administration. Also, he might or might not be qualified or have the time to properly supervise these important functions. To a certain extent the success of this arrangement would depend on how well the physical plant director and the facilities planning director like, respect, and relate to one another.

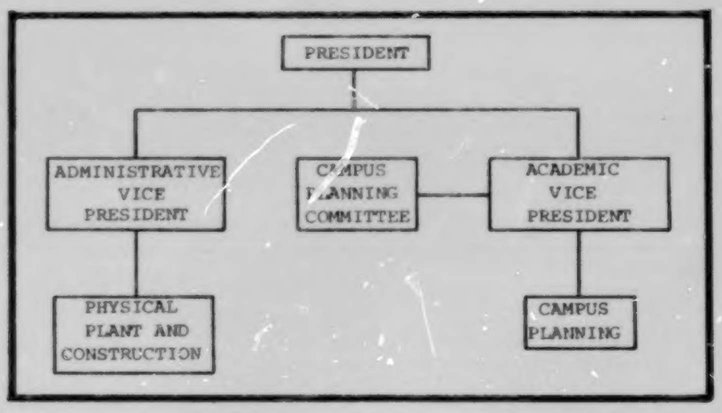
PRESIDENT
ADMINISTRATIVE VICE PRESIDENT
CAMPUS PLANNING COMMITTEE
ACADEMIC VICE PRESIDENT
PHYSICAL PLANT AND CONSTRUCTION
CAMPUS PLANNING

Chart 4. This arrangement has little to recommend it. There needs to be continuous contact between physical plant and campus planning. Their relationship should be as close as possible. This type of organization separates them as much as is possible.

of schools do combine planning and construction in one department and that about one-half of the schools place them in the Department of Physical Plant while the other half are administered in departments with an assortment of names. Of those schools reporting that their planning and construction were in separate departments, none reported that their planning office was in the Department of Physical Plant; but all reported that construction was the responsibility of the Department of Physical Plant.

Although schools are organized differently to handle planning and construction and will likely continue to do so, it does seem logical to have planning, construction, maintenance, and operation all in the Department of Physical Plant and to have a man trained in engineering, planning, or design and with considerable organizational and administrative ability coordinating the work of those closely related functions. There is merit in the president's being able to hold one man instead of two responsible for the total program. Otherwise, if the head of planning and the head of Physical Plant don't get along with one another, the president has a personnel problem on his hands, and the school's physical facilities program will likely suffer. Construction and maintenance people are needed during the planning stages of small and large projects; architects and engineers are needed during construction. If the personnel are in separate departments, they are constantly travelling back and forth seeking each other's counsel, advice, and cooperation. Why not place them all in one department? One architect who heads a department of planning was heard to say, "I wouldn't work in Physical Plant because they'd place restrictions on my budget." Budgets are an administrative matter, and planning could fare just as well in the Department of Physical Plant as it could off by itself. Professional jealousy or pride was probably the real reason for not wanting to be in Physical Plant. If for some good local reason the functions of planning and construction cannot be located in the Department of Physical Plant, then they should be housed in the same building, if possible. It is essential that there be close and regular contact between personnel of the departments; and the closer they are physically, the easier and more likely those contacts will be.

No matter what form the organization chart for planning, construction, and maintenance and operation may take, in the final analysis the best plan is to secure the most capable and experienced men available; carefully outline what is wanted; give them the authority to go with their responsibility; keep the lines of communication open at both ends; provide a reasonable budget; and supervise and make policy decisions, but keep it in channels. When a good job is done, a pat on the back and a word of praise will count almost as much as a pay increase. But when the work is repeatedly unacceptable, the man responsible should be replaced by someone who can handle the job. Physical Plant development, maintenance, and operation is a big business, and it should be handled in a businesslike way.

## Central Planning Office

Perhaps the best way to understand the need for a central planning office is to examine some past mistakes, some of the objectives of planning, the qualifications of personnel, and the value of such an office. Examples of costly problems brought about by inadequate academic and physical planning on college campuses are numerous. How many veterinary facilities, animal-husbandry buildings, agricultural research plots, and similar items at land-grant universities have been moved to make room for their expanding inner campuses? Stadia and athletic facilities have been forced out of their established locations for the same reason. Electrical substations, power lines, and utilities of all kinds have been inadequate or in the wrong place. Dormitories, the Physical Plant building, and auxiliary projects once on the periphery of the campus are suddenly in the way and must be moved—or "leapfrogged." Neither choice is good. The first is terribly expensive; the second, illogical and inconvenient. It is possible that literally millions of dollars have been spent on remodeling that could have been largely prevented if careful and professional academic programming had been done and the architects closely checked for compliance. A library planned for the center of the campus and built accordingly could someday find itself closer to the edge of the campus because the possibility of extensive future growth was not recognized or because its location was expedient at the time.

A classroom building, an engineering building, a science building, and a chemistry building might all be shown as part of a beautiful symmetrical quadrangle closely surrounded by other specialized buildings. It would look good on paper, and it would look good in a model and from an airplane. But what happens when another engineering building is needed? The only solution (short of tearing down a perfectly good engineering building) is to leapfrog over all the other buildings and separate the engineering buildings by a considerable distance. It might still look good in a plan and in a model and from an airplane, but functionally it would leave a lot to be desired.

Poor vehicular and pedestrian circulation is a major problem at almost all schools. The mixing of architectural styles and character of campus buildings, approved by some, will offend others. Improper building orientation necessitates higher fuel cost and excessive use of sunscreens.

All these examples and more can be found on most older campuses and, unfortunately, on some of the newer ones. Some past mistakes are excusable. How, for example, could early school officials and planners have known that their small college would some day become a large university covering hundreds of acres and with physical problems similar to those of a good-sized city? How could they have known years ago that the additional land they would require would later cost a thousand or perhaps several thousand times more than it could then be purchased for?

Today a new and hopefully fresher and more comprehensive approach to university and college planning is being taken. This approach recognizes that because physical planning is so closely related to academic planning, the two cannot be separated.

> *What then is the mission of planning for the college—new or old—today? In my opinion, its mission is to provide the appropriate environment to encourage the educational process. It is not to simply provide a building or buildings, because no building ever educated a student. The physical college, when successful, is the result of the appropriate blend of the aesthetic and practical. College planning has advanced considerably from the days of just making things do. It has been forced by circumstances to become both an art and a science. It is now evident that the planning problems can only be solved when approached in a spirit of pure research and analysis.*[4]

There is so much more to campus planning than buildings of fine architectural character, beautifully landscaped grounds, and a fine symmetrical arrangement of structures. Some campuses may have all that and still not provide the arrangement of buildings and spaces within the buildings needed to serve the academic needs of the school adequately. Buildings should not only look good; they must be made to serve their intended users well and faithfully. And they should also be built to last and to require minimal maintenance.

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[4] William L. Pèreira, A.I.A., "College Planning Today," Paper given at the Forty-First Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, California Institute of Technology, 1954.

*Hidden within the term facilities planning and underlying the total physical planning process is a need to insure a high-quality aesthetic environment. This means that campus planning must concern itself with appearance in new academic facilities. Equally important is the liaison linkage with the Physical Plant Department to minimize, wherever practical, the inclusion of high-maintenance buildings or facilities.*[5]

A beautifully delineated master plan can be produced in a relatively short time by a few talented people. And almost any architectural firm can produce a good-looking, structurally sound building in a few months. But producing a superior building requires more than planning and architectural skill. It requires extensive and basic knowledge of how a campus really functions and of how a building is to be used. Such information is not likely to be adequately gotten in a few weeks or even months. Understanding the needs of those who daily work, live, and play on a university or college campus requires intimate association with university life over a long period. If a campus planning consultant could work on a campus long enough to get to know intimately the daily problems that confront personnel in Physical Plant, Auxiliary Services, Security, and Athletics, as well as the faculty, staff, and students, he could produce a plan that would not only provide for an attractive campus, but one highly realistic and functional as well. If an architect could be exposed daily to the demands, needs, complaints, and changing requirements of the faculty of a department or of a college, he would be much better prepared to produce a building that is not only structurally sound and good-looking, but that also more nearly meets the needs of its users. Obviously no outside professional consultant, whether he be an architect, engineer, landscape architect, or campus planner, can do that and still give full attention to his professional practice.

*For years I have heard architects criticized for their shortcomings in connection with their work on college and university buildings. All of us have had experiences which have at times made us critical of the profession. However, I have reached the conclusion that a goodly share of the fault lies with the institutions. In too many cases, too much responsibility is given to the architect and not enough responsibility is assumed by the school. In too many cases the architect is not given the information necessary to design a*

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[5] Robbins, "Campus Planning."

*building to properly serve the functions that will be housed there. (This is the fault of the school.) In too many cases the staff and operating personnel are not given the opportunity or sufficient time to properly review preliminary drawings before the architect is authorized to proceed with working drawings. (This is the fault of the school and can and will result in many needless costly mistakes.) In too many cases final plans are put out to bid without careful checking by qualified university personnel. (This is the fault of the school.) In twenty-three years I have never seen a set of working drawings that was not greatly improved by a careful pre-bidding review by the technicians in the Department of Physical Plant.*[6]

How can a school best insure that its interest is well represented during all stages of planning and construction? The best answer is to have a central planning office headed by a professionally trained and experienced campus planner.

*The sudden emergence of new colleges, as well as extensive growth plans by older schools, has created a need for a new kind of college administrator usually entitled, 'The Campus Planner or Campus Planning Coordinator.' Basically, his job is one of liaison—helping to draw faculty and administration ideas together into compilation of space requirements and functional relationships generally called the architect's program or educational specifications. It is also his duty to see that the architect follows these specifications in providing well-designed spaces.*[7]

Interpreting the school's needs through good programming so that consulting architects and engineers can move quickly and confidently into actual planning is an important part of the campus planning coordinator's job. A permanent employee of the university in daily contact with its people, problems, and requirements is in the perfect position to give valuable professional assistance to the school's consultants. But there is so much more he and his staff can do. They can keep the master plan up to date. They can prepare plans and specifications for countless remodeling and alteration projects. They can do grading plans, site-development plans, sprinkling and planting plans. They can keep a record of all utilities and be the "keeper" of all plans and specifications of all projects done on the campus. In short, the campus

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6. Sam F. Brewster, "Programming, Planning, and Construction of College and University Buildings," Paper given at Fiftieth Annual Meeting, Association of Physical Plant Administrators of Universities and Colleges, University of Chicago, 1963.

7. John Beynon, "Campus Planning: Review and Preview," Report from the School Planning Laboratory, School of Education, Stanford University, Western Regional Center, Educational Facilities Laboratories, Stanford, California, n.d.

planner and his staff could do about everything except design major buildings and engineering projects.

What qualifications should a campus planner have? Should he be an architect, an engineer, a landscape architect, or an urban planner? The choice seems to be a wide one. The information on planning in Appendix A indicates the professional training of forty-one campus planners: nine are architects, eight are civil engineers, five are mechanical engineers, and the rest range from electrical engineers and landscape architects to three who list experience as their qualification. Whatever his professional training, the campus planner must understand the problems of his school and have respect and confidence among his academic colleagues and among outside architects, engineers, landscape architects, and other professional people he will work with. The better he understands, interprets, and coordinates the plans of both groups, the more successful he will be.

> *What kind of background best qualifies a person for this work? The job requires a generalist who has sufficient grounding in instruction, administration, architecture, planning, and finance to enable him to communicate with persons of all these fields. One alternative is to assign a person already familiar with a school's physical problems and its politics and educate him in their language of architecture. On the other hand, one might add a professional staff member or hire a consultant who has training and experience in planning and educate him in the local problems and policies. Experience has shown it is preferable for this person to be grounded in higher education rather than architecture. This insures that the school's educational objectives dominate the planning.*[8]

The central planning office idea is not new. Most schools have had such an office in one form or another for years. However, the idea still prevails that only large and affluent universities and colleges can afford offices staffed with sufficient personnel to handle their planning problems. Part-time and full-time consultants are still being used and often at a greater expense than similar full-time people would cost. As an example, one school was using a consulting firm to advise them. For this service, the university paid the firm a flat fee of forty thousand dollars per year. For their money, the school received the part-time service of one man and the occasional services of the head of the firm. Finally, the school employed the part-time man they had been getting. Thus at a considerably lesser cost than they had been paying to the consulting firm for part-time help, they had the full-time services of a highly capable man.

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[8] Beynon, "Campus Planning: Review and Preview."

> *I am, of course, well aware that only the largest universities can afford to maintain a staff of specialists. The others must depend on part-time consultants, architects, landscape architects, and engineers. The point that is important is that planning is a continuing teamwork function. You can't hire separate specialists at separate times and expect their work to jive.*[9]

The size of a planning office could range from one campus planner at a rather small college, where a single building every few years is standard, to a staff consisting of a campus planner, engineers, an architect, a landscape architect, draftsmen, an estimator, a specification writer, and building inspectors at a large university, where planning and constructing new facilities, and remodeling older ones, are done on a large scale.

Considering the original cost of programming, planning, and constructing buildings, and the later cost of maintaining them, it is hard to understand how a school can afford *not* to have a central planning office. There are so many ways to save money in a building program. And a capable school planning staff in, or very closely associated with, the Department of Physical Plant is the best guarantee of such savings.

### Physical Plant Department

There was a time when buildings and grounds departments were responsible for little more than housekeeping duties. The departments were staffed with janitors and jack-of-all-trades handy men. The superintendent in charge of the department was seldom a college graduate. Work orders and a businesslike operation were the exception rather than the rule. As late as 1940, one superintendent of buildings and grounds issued instructions to his men on a grocery-store order blank. It was used because it had a carbon between the first and second sheets. The orders were generally handwritten, and the original went to the shop or person involved. The carbon copy was filed on the superintendent's desk, the "file" being a twenty-penny nail driven through the center of a piece of wood. When the file filled up, the copies were thrown away and a new collection started. Fortunately, this was not typical. Long before that time many schools had recognized the importance of developing and maintaining their plants, and they had developed plant systems and staffed them with skilled specialists.

In 1914 a small group from some fifteen midwest universities and colleges met in Chicago and formed the Association of Superintendents of Buildings and Grounds of Colleges and Universities. The purpose of the association was to enable its members, through exchange of information, to become better informed to meet the increasing need for plant-management expertise. The growth of the association was slow, but it has continued as an association to the present. In 1937 there were only 48 members. In 1940 there were 63 members. In 1947 there were 100.

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[9] Sam L. Huddleston, Landscape Architect, Denver, Colorado, "Landscape Planning," Paper given at the Seventh Annual Meeting of the Rocky Mountain Regional Association of Physical Plant Administrators of Universities and Colleges, University of Colorado, 1959.

Now the Association of Physical Plant Administrators of Universities and Colleges, with a membership of over 1,000, describes itself as "an association international in scope, founded in 1914, whose purpose is to develop standards in the administration, care, operation, planning, and development of Physical Plants used by colleges and universities."

The tremendous expansion of educational facilities in the years following World War II called for a new type of Physical Plant man and for sizable and versatile departments of Physical Plant. Today virtually all heads of Physical Plant departments have degrees, and many have advanced degrees. Some of the best engineers, architects, landscape architects, and professional men to be found anywhere are now directing Physical Plant departments. These men have been recruited from the faculties and staffs of their school, from industry, and from their professional practices.

Physical Plant directors today, with rare exception, are professionals and should be recognized as such. They have one of the toughest jobs on a campus, and each is responsible for many millions of dollars worth of property. In the few instances where labor unions have called strikes of Physical Plant personnel, the campuses affected were practically shut down. A Physical Plant director today must not only be a good engineer, but he must also be good in organization and business procedures.

> *The successful director must examine not only the needs of the physical facilities on his campus but the needs of the entire academic community and be prepared to cope with these needs as they develop. He should be conversant with the probable trends and changes that will take place in the academic field of his institution. He must develop the know-how and be equipped to deal with and work with technological changes and advise his superiors on ways and means in which these can be employed more effectively in his own work.* [10]

Several Physical Plant administrators now carry the title of vice-president or assistant vice-president. Schools are showing their appreciation of their Physical Plant directors by naming buildings after them. Dr. Bruce R. Poulton, chancellor of the University Systems of New Hampshire, summed it up well in his keynote address at the Sixty-Third Annual Convention of the Association of Physical Plant Administrators of Universities and Colleges in 1976. He said,

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[10] Wesley Hertenstein, former Director of Physical Plant, California Institute of Technology, Keynote Address, Fourteenth Annual Meeting, Pacific Coast Association of Physical Plant Administrators, University of California, Davis, 1967.

> *If physical plant administration ever was thought to fall appropriately into some kind of secondary executive category, and at least in some places perhaps it was, it certainly cannot be so relegated today. It cannot be so relegated by anyone—particularly not by you. The professional demands in this area of physical plant administration have increased faster and to a greater degree than in any other area of academic administration. By whatever title you are called in your own institutions—director, vice president—the functions and the conduct of your position are as vital to the continuing progress of the institution as those of the dean of the faculty or the vice president for academic affairs. I am convinced that they must be viewed as such and that there can be no effective dealing with the changing aspects of the job unless and until this view is accepted.*[11]

At the same convention, Dr. George F. Baughman, president of the College Foundation, Sarasota, Florida, envisioned a continued upward trend:

> *Since the requirements and support for the physical plant is a substantial percentage of the institution's budget, in today's climate, the physical plant director is one of the key men of the hour. Professional competency has paid off most creditably in the past and it will in the future. Your success in finding ways for greater efficiency, environmental and conservation considerations, a goal to achieve a dialogue between fiscal and academic planners are going to be recognized as a "must" in the progressive and successful institution of tomorrow. Your place in the future is assured.*[12]

The question is often asked, what is the best training for a Physical Plant director? That is not the easiest question to answer; but whatever else he is trained in, the really good director is going to be a capable administrator. A director of Physical Plant must make many administrative decisions daily. He must organize a department of people with an unusually large number of

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11. Dr. Bruce R. Poulton, Chancellor, University System of New Hampshire, "The Professional Physical Plant Administrator's Role in the Future," Address to the Sixty-Third Annual Convention of the Association of Physical Plant Administrators of Universities and Colleges, Atlantic City, New Jersey, 1976.

12. Dr. George F. Baughman, President, The College Foundation, Sarasota, Florida, "Education Facilities in the Future—Professionalism Will Meet the Challenge," Address to the Sixty-Third Annual Convention of the Association of Physical Plant Administrators of Universities and Colleges, Atlantic City, New Jersey, 1976.

diversified skills and responsibilities. His decisions will affect, not only his own department and personnel, but the personnel in other departments as well. He will not be on a drawing board or engaged in repairing a leaky condensate line, cleaning a building, or laying up a brick wall, but he will coordinate the work of people who do those things—and much more.

Because he is an administrator and a coordinator and because campus planning, construction, and maintenance and operation are so interrelated, it is logical to make the director of Physical Plant and his department responsible for all three functions.

In fact, such a link is so logical that it is hard to imagine why the functions were divided in the first place. It has been proven on many campuses that consulting architects and engineers can work with Physical Plant personnel just as well as or better than they can with similar personnel in a separate planning office. It is time to stop thinking of Physical Plant as a housekeeping department and to begin thinking of it as a department of professionally trained and experienced people who most logically should be responsible for all phases of plant development and care. The question is, why are several individuals and departments doing parts of the same job when one department could assume total responsibility? Divided responsibility is seldom good; and where so much money is involved, and where the decisions made will affect so many people for so many years, it is certainly better to consolidate the responsibility for all physical facilities into one department. Perhaps the existing Department of Physical Plant is not staffed to do all that is required. Then the correct move would be to evaluate existing university personnel, acquire new personnel where needed, and reorganize the Department of Physical Plant so that it can assume its proper role in the institution.

### Campus Planning Committee

Many institutions of higher learning today have some form of a permanent long-range planning group. These groups go by different names, but their duties are essentially the same. Some of the more common names are: Campus Planning Committee, Long-Range Planning Committee, Campus Development Committee, Long-Range Facilities-Planning Committee, and Campus Development Planning Committee. There are undoubtedly other titles used, but the name isn't what is important. What is important is how well the committee serves the institution. Whether it serves well or just exists depends on many factors, but its value can be so great when properly used, that any institution without such a committee should give serious thought to establishing one. Any school with a committee of this kind that is not functioning properly should not question the need but should determine what is wrong with the committee and do something to correct the situation.

As a general rule, such committees fail to produce efficiently when they are too large, when they do not have proper representation, when they do not have a clear channel of communication with the school's chief administrator, when they become involved in too many details that could better be handled by the Department of Physical Plant, when they have not been thoroughly briefed on the long-range concepts of the university or kept up to date on policy changes, or when the administration does not consider seriously their recommendations.

A look at Appendix A will show that of the forty-two schools reporting on planning, twenty-five had campus planning committees and seventeen did not. Among the twenty-five schools with some form of a campus planning committee, eighteen report directly to the president or to the chancellor. The rest report to vice-presidents and business managers and, in one school, to the board of trustees. When asked if the recommendations of the committee were given serious consideration by their top administrators, twenty-four said yes, and one did not reply. What does not appear in Appendix A is the great variations in membership of the committees. Some were small, with only four or five members, and some were large, with a dozen or more members. The number of high-ranking school officials who served on the committees indicates that many school officials feel that their campus planning committee is of greatest importance. For example, at one sizable state university, the committee is composed of the president as chairman, the vice-president for administration as vice-chairman, the director of Facilities Planning as executive secretary, the vice-president for academic affairs, the dean of professional schools, the dean of Agriculture, the business manager, the director of information, the chairman of the Faculty Policy Advisory Committee, the director of Physical Plant, the president of the student body, and two other students. At a Canadian university, the Campus Planning Committee is composed of the vice-president for administration as chairman, the director of Campus Planning, the director of Physical Plant, the director of university facilities, the chairman of the Academic Planning and Policy Committee of the Senate, the master of a college, the associate dean of the Faculty of Arts, the professor of a college, and the president of the council of the University Student Federation. At a small state college, the Campus Planning Committee is composed of the president as chairman, the financial director, the vice-president of academic affairs, and the director of Physical Plant. At a large land-grant university, the committee consists of the director of Physical Plant as chairman, the campus planner/architect (a permanent member), the business manager (a permanent member), a faculty representative from the School of Agriculture (three-year term), a faculty representative from the School of Architecture (three-year term), and a faculty representative selected from one of the other schools (three-year term). At a large private university the very successful Campus Planning Committee is composed of the assistant vice-president/Physical Plant as chairman, the executive vice-president, the vice-president for academic affairs, and the director of Space Utilization.

The Campus Planning Committee should not attempt to take the place of a central planning office of full-time professionals.

> *Though it is sometimes possible to appoint specialists such as social scientists and architects to be members of a campus planning committee, no such committee can function to its best advantage without a paid technical staff of well-qualified personnel. Ex officio members, as well as committee members who are specialists, may be of great assistance in advising a body on matters in which they have special knowledge. The committee, however, should not be expected to devote much time outside of its regular meetings to act other than in an advisory capacity to the college and university administration. Where the college is small, and the planning committee is also proportionately small in number, I still believe there ought to be a technical staff serving a committee even if the staff is composed of only one person employed on a part-time basis.*[13]

It is doubtful that the committee should be more than advisory to the president. However, the caliber of persons appointed to the committee by the president should be such that he and his immediate staff would give any of its recommendations prompt and serious consideration. It should be a permanent committee (never ad hoc), and its membership should consist of some of the most knowledgeable and experienced administrators and other people on the campus. As these are some of the busiest people on the campus, it is often difficult to get them together. This is another reason for not having too large a committee. New appointments to the committee will have to be made periodically, but if there is to be continuity of policy and knowledge of the detailed work of the committee, a majority of the members should be experienced.

The committee needs a permanent meeting room, preferably adjacent to where the technical planning staff works. In this location, professional full-time people are available for consultation, and records, maps, drawings, and other basic reference materials are at hand. The committee can have a regular meeting time, or it can be called together by the chairman as needed. The

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[13] Samuel P. Snow, Professor of Landscape Architecture, Auburn University, "An Approach to Campus Planning," Paper given at the Fortieth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Auburn University, Alabama, 1953.

The Campus Planning Committee at work. Note the foot markers, near the ceiling, used to help planners visualize dimensions. Note also the master plan on the wall, where it can easily be referred to. The framed perspectives were submitted by architects as part of their preliminary plans.

committee room should have one-foot spaces marked off both horizontally and vertically on the walls, because many persons cannot visualize dimensions. As an example, a department chairman was insisting on an office 20 feet by 20 feet. The campus planning committee was meeting in a room that was 18 feet by 26 feet. When the department chairman was asked if an office the size of the committee room would be adequate, he looked around and exclaimed, "One that's half this size will be just fine!"

The amount of detail a Campus Planning Committee goes into depends to some extent on how good a professional and technical staff it has. Where there is a good planning office, much of the work of preparing preliminary programs of building requirements and critiquing plans can be done in that office, and the committee can be briefed and its work greatly expedited. Although each Campus Planning Committee will probably conduct its business differently than similar committees at other schools, there are some things that any committee could do to advantage. Much good could be accomplished if deans, directors, and department chairmen would meet with the Campus Planning Committee to discuss their building needs and problems. Through this sytem of reviews and discussions, committee members would become familiar with the physical problems and needs of the various departments and colleges. With this leverage, they could do much to turn off unneeded or improper requests and could be equally effective in helping to develop and channel essential projects. Through their experience and overall knowledge of the needs and policies of the school, the Campus Planning Committee could exert a large amount of influence over individual ad hoc committees as to building sizes, extent of development, and cost of projects.

It would be desirable for the committee to review building programs as they are developed by ad hoc building committees, because one of the important duties of the committee could be to see that the "squeaking wheel does not get all the grease." One dean might insist on a 400-square-foot office and keep insisting until he gets it, while a less persistent dean of equal rank and responsibility would gladly settle for one of 250 square feet. (The committee should not let that happen unless there is a really good reason.) A professor might insist on classrooms with 20 square feet per student station where 12 to 15 square feet would be ample. (The committee and the technical staff should know what is needed and be prepared to refute such requests.) An ad hoc building committee may insist on a building of 125,000 net square feet, but if the request is "dewatered" by the Campus Planning Committee members who have had experience with similar requests, it is most likely that a building of 100,000 net square feet can be produced that will satisfy the functional requirements of its occupants. With the high cost of construction, it is essential that every possible unneeded square foot in a building be eliminated; and a good way to do that is to subject each program developed by an ad hoc building committee and every plan developed by an architect and engineer to the closest scrutiny possible by the Campus Planning Committee and the professional and technical staff in the Department of Physical Plant.

Another function of the Campus Planning Committee would be to interview and screen applicants for architectural and engineering contracts. It certainly should review all plans and specifications submitted by architects and engineers and, when satisfied with the plans, recommend to the president of the school that they be accepted. Likewise, the committee should review plans and specifications for major alterations, additions, landscape projects, and other major jobs whether done by school personnel or by outside professionals. The committee should see that the campus master plan is kept current and that its basic integrity is maintained.

There is probably more that a Campus Planning Committee can do effectively, but its principal duties seem to be to interview, consult, review, and make recommendations to the president. It should not attempt to do work that can be done far better by full-time professional and technical staff members. However, it has been proven that when the technical staff and the Campus Planning Committee work together as a team much good can be accomplished.

## Ad Hoc Planning Committee

Planning a university or college building is a complicated process if done properly. To enable an architect to design a building that will meet the requirements of the many highly skilled specialists who will use it requires a great deal of advance planning on the part of the future users themselves. It is surprising how many differences of opinion can develop between the faculty and staff of a single department, much less of a college; yet these differences should be largely resolved before an architect is involved. The architect cannot afford to spend the time it would take to hear scores of people attempt to explain their ideas of what is needed. If the architect is forced to proceed in this manner, the result may be an attractive, structurally sound building that falls short of what is functionally needed. The problem is how to reconcile differences of opinion between staff members, give everyone concerned a chance to be heard, and get it all down in writing in such shape that those who will first occupy the building will certify that what is contained in the document is what they want, or that it is acceptable.

The written program of requirements is one of the most frequently used methods of transmitting the needed information to the architect. When the question was asked of forty-two universities and colleges if they prepared a written program of requirements for major projects, thirty-six said they did, five said no, and one did not answer. It is not known whether all these schools use ad hoc planning committees to help prepare their written programs of requirements, but probably most do. The size and composition of membership on the ad hoc planning committees that prepare programs will vary, but the purpose is the same—to write the requirements so that the architect can proceed with planning. Ad hoc committees range in size from four or five members to an unwieldy twenty-five or thirty. Experience has shown that a committee of five to nine members carefully selected can work together efficiently and also represent all interested users of the building. The committee has such an important role that it should be appointed by the president. Often a dean is made chairman and department heads are put on the committee. There should be an experienced programmer from Physical Plant or from the Campus Planning Office on the committee to give professional planning and construction advice. The programmer may also be responsible for editing the final program of requirements and having it reproduced, printed, and distributed. It is advisable to appoint an ad hoc planning committee for each building project approved for programming. Each should be dissolved by the president when its assignment is completed. These committees should not be confused with permanent Campus Planning Committees, which (among other duties) work closely with each ad hoc planning committee.

According to Richard A. Eustis, director of Physical Facilities, University of Maine, "The office of Physical Facilities assists the campus president in forming a building planning committee on his campus. The Assistant Director for Planning becomes an ex officio member of that committee and guides the committee through the writing of the conceptual plan."[14]

Kenneth E. King, director of Physical Plant at Goshen College, writes,

> *When new facilities are needed, the department head makes a request to the president who, in counsel with administration, approves or disapproves further planning. If approved, the president appoints a committee from the department which does a major study of their needs and requirements. After the administration approves the requirements, the architect is commissioned to prepare preliminary plans.*[15]

At South Dakota State University, Ken S. Hayter, director of Physical Plant, retired, indicates they do it somewhat differently. He states, "As projects on our capital improvements request list approach a high priority, we prepare a building program which is reviewed by the Regents. The Regents then allocate planning funds and an architect/engineer is selected. . . . The project committee appointed by the president is responsible for writing the final program, using the consultant's report, if any, as a guide but not as a directive."[16] According to Raymond Halbert, director of Physical Plant and Construction, University of Missouri, "A program for a facility is prepared by the architect/engineer and Director of Physical Plant and Construction together with an ad hoc committee of the using department. The ad hoc committee together with the Director of Physical Plant and Construction and his assistant and/or Vice President for Business Management review closely the preliminary sketches, and finally select a plan which will meet the department's needs . . ."[17] (They do not have a campus planning committee.)

At Brigham Young University, the president appoints an ad hoc planning committee for each building project. This committee generally consists of seven persons, and they are guided in their work by a programmer in the Department of Physical Plant. The work of the ad hoc committee is reviewed, as its work progresses, by the assistant vice-president of Physical Plant and by the Campus Planning Committee. The president is kept informed, and he advises on matters of policy. Then, after the preliminary program is developed, an architect is appointed. After a field trip and with input from the architect, the program of requirements is finalized and approvals are obtained. The architect is then authorized to begin work. Once he starts, the ad hoc committee works closely with him through the school planning staff, especially during the schematic and preliminary stages. As the architect prepares working drawings, the ad hoc committee has less frequent contact with him, but is available when needed. During construction the committee is involved in selection of furniture and equipment and is consulted concerning building decor. When the building is accepted and occupied, the ad hoc committee for that building is dissolved.

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[14] Richard A. Eustis, Director of Physical Facilities, University of Maine, Response to Author's Questionnaire on Planning and Construction, 1975.

[15] Kenneth E. King, Director of Physical Plant, Goshen College, Response to Author's Questionnaire on Planning and Construction, 1975.

[16] Ken S. Hayter, Director of Physical Plant (retired), South Dakota State University, Response to Author's Questionnaire on Planning and Construction, 1975.

[17] Raymond Halbert, Director of Physical Plant and Construction, University of Missouri, Response to Author's Questionnaire on Planning and Construction, 1975.

The primary duty of an ad hoc planning committee is to prepare a list of requirements for the building they will later occupy. As most persons will serve on such a committee only once, it is advisable at the outset to supply the members with basic information on how to prepare a program of requirements. Also, it is almost essential that the committee receive professional and technical assistance from the Department of Physical Plant, the Campus Planning Office, or both, as its work progresses. How to produce a "Program of Requirements" is discussed in some detail in chapter three.

### Consultants

A consultant, according to Webster, is a person who gives professional or technical advice. Another, perhaps more common, definition is, "A consultant is just an ordinary fellow a long way from home." Whether the consultant gives advice or charges for it and whether he comes from near or far, there are times when his assistance on some phase of planning and construction is desirable.

In this age, when new and often better ways of doing things develop so fast, only a specialist can hope to keep up with current thinking in his field. A university or college faculty and staff is made up of specialists in many and varied fields of endeavor, and often the best advice possible on a given subject can be obtained from a member of the school's staff. But there are times when even well-informed local people can profit by bringing in a nationally or internationally recognized expert. There are at least two things to recommend this practice: (1) The consultant will—or should—know more about the subject under consideration than anyone locally. (2) Bringing in an expert with a long list of notable achievements to his credit might well provide the prestige and credibility needed to make the project salable.

There are times when the consultant does little more than restate what has already been said locally. Sometimes he may simply confirm the action that has locally been proposed. Again, the consultant's reputation and objective participation might well be all that is necessary to get the project "off dead center and moving."

There are, of course, different types of services consultants can render. For example, a library consultant might spend only two or three days advising with the library staff, and his recommendations could be summed up in a fairly brief written report. If a new library building is being programmed, the consultant might spend a few days with the library ad hoc planning committee. He might travel with a select group to look at some recently constructed libraries and point out to the group the desirable and undesirable features of the buildings. Again, his report would be in written form with few if any sketches.

The architect commissioned to do an arena or perhaps an auditorium might recommend that an acoustical consultant be employed to advise on acoustical matters and to design the sound system. This expert would not only discuss the problems and solutions with the architect and the owners, but he would supply detailed drawings and specifications to supplement those done by the architect and his structural, electrical, and mechanical engineers.

When a school recognizes the need for a consultant, or when an architect recommends that a consultant be employed, usually the first question is "Who?" This question shouldn't be too difficult to answer if politics are kept out of it. Really good consultants in specialized fields are generally well known by persons in related work. The school librarian will most likely know who is being widely used and acclaimed by other libraries and librarians. If he does not know, his colleagues around the country can soon provide the information. Any architect selected on the basis of his ability and experience to do a building requiring sophisticated acoustical treatment and sound system, will likely know some of the most highly successful men in the acoustical field. If he does not, someone on the school's staff probably will. A few letters of inquiry and perhaps an interview with one or two prospective consultants should produce the right man. Some national school associations keep a "Consultants File" to help schools. As various persons at any university or college are members of the different associations, it is easy to have those sources checked.

Consultants' fees and expenses are rather high; therefore, a school would be ill advised to rush out and employ one unless there is a proven need. It may be an easy way to help solve a problem, but if the problem can be solved satisfactorily by school or local people, the school would do well to have them solve it. Consultants' fees may range from a low of fifty dollars a day and expenses to several hundred dollars a day and expenses. Where a consultant furnishes plans and specifications, he might also require a stipulated percentage of the construction cost of whatever he designed. In such a case, the school will be required to pay his fee unless a previous arrangement has been made with the architect for him to pay the consultant out of his architectural fee. When consultants are employed to work with architects, it is important that all financial arrangements be thoroughly understood by all parties concerned before contracts are signed. Also, it is important that the consultant and the architect be mutually acceptable. If he is paid by the school, the consultant might feel that his loyalties and concerns should be for the owner. If carried too far, this attitude might strain his relations with the architect. The truth is that both the architect and the consultant are working for the school, and they should combine their talents to provide the best possible facility for their client.

A consultant might give poor advice or recommend something that if carried out would cause the institution serious operational or financial loss. There would appear to be two responsibilities a consultant would have in such a case, the first moral and the second legal. In the case of the first, it is doubtful that the school could go into court and get a judgment against the consultant because of his moral obligation. If the consultant had given verbal assurance that he would be responsible in case of failure, it is doubtful that restitution could be obtained through process of law if he chose to breach his promise. On the other hand, there might be opportunity to obtain redress if the consultant's responsibility were spelled out in a legal contract. If the school believes that serious problems might develop, it would be wise to secure legal counsel before finalizing a contract or agreement with the consultant.

Schools should not become dependent on consultants for continuing operational programs. The school that continues to rely on a landscape consultant for guidance on routine landscape problems would do better to have him advise the responsible school staff and help them get so well organized that when he left for home, the school staff could function competently on their own. The same could be said for many similar situations.

There are numerous places in a planning and construction program where a consultant could prove of value. Some have been mentioned, but the following is an abbreviated checklist of areas in which consultants might be useful:

1. Helping program specialized buildings and specialized spaces in buildings.
2. Discussing with the school administration possible future curriculum changes that might influence building design.
3. Advising the architect on problems with which the architect is unfamiliar and providing him with details to help solve design problems.
4. Critiquing building plans during the schematic and preliminary design

stages and advising the school staff and the architect on any recommended changes.

5. Serving as arbitrators when arbitration is called for.

In addition, consultants can advise the school and the architect on such diverse matters as acoustics, sound, landscaping, interior design, office arrangement, structural design, roofs, and lighting. And the list could go on. Consultants are available in all those areas; so, if the situation seems to justify a consultant, select one carefully and use his services to help obtain a better facility. (See an independent consultant agreement in Appendix C.)

### Summary

Good organization is essential at all levels if planning is to be done professionally and efficiently. There should be a direct line of communication between the campus planner and the president. Every school should have a central planning office scaled to its needs. The Department of Physical Plant should be organized and staffed to make it responsible for all phases of planning, construction, and maintenance and operation. A Campus Planning Committee can be a most important part of campus development. Ad hoc planning committees can be very effective in programming requirements for new facilities. Consultants can be helpful in many ways, but a school should not become too dependent upon them.

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# Basic Planning

## Academic Planning

During the first part of this century, experts in school planning and operation were still debating the advantages of electric lights over kerosene lamps. States were enacting laws against the common drinking cup. Septic tanks were beginning to replace privies at some schools. Many schools had not developed good systems of lighting, heating, ventilation, sanitation, and water supply.

Today, the electrical and mechanical costs of a complex modern university or college building represent a large percentage of that building's total cost.

Wonderful strides have been made in curricula and in the physical development of schools in the last fifty-five to sixty years, but it is quite probable that the next few years will see even more changes in the *way* students are taught as well as in *what* they are taught, and in the required teaching facilities, than has been the case in the last fifty years. The certainty of vast and rapid changes in current educational programs will require some real soul searching among top administrators and faculties of every institution of higher learning.

How future students are to be taught and what they are to be taught are questions for which physical planners need answers—answers not based on what a small group of current occupants want for their own specialized uses, but based on what the institution needs to complement and serve its long-range educational objectives. To plan a physical facility without the benefit of a carefully thought out and officially approved long-range academic plan is to take unnecessary chances. However, physical planners are constantly called upon to do just that. At a seminar conducted by John W. Harding, of the University of Washington, and by Terry L. Suber, of the University of California, Davis, at the forty-eighth annual meeting of the Association of Physical Plant Administrators of Universities and Colleges at Oregon State University in 1961, only one or two out of a group of approximately forty indicated that their campuses had an academic plan, but all expressed the opinion that it is an essential item. Without it, the group felt, physical planning tends to dictate academic planning. The group further expressed their feeling that even without a complete academic plan, basic decisions as to the objectives and programs the schools wanted to achieve would be a great help in physical planning.

"It's inconceivable to me that in planning or elsewhere, the solution to a problem would be sought before the problem is defined. And yet in my experiences on a number of campuses, when we seek to develop a long-range campus plan, the hardest information to get—and usually the last—is the objectives of the institution, its goals, its place in the system of education."[1]

> *I believe that one of the major problems in campus planning has been that long-range educational planning has not preceded campus plan studies. Campus planning should serve to facilitate the university's teaching, research and service programs. Therefore, a campus plan to fulfill its purpose should be based upon the stated educational philosophy and objectives of the university. Such a statement should provide the basic information and the direction and magnitude of the university's growth. Educators are usually reluctant to provide such statements, partly because the educational program is changing so rapidly that they cannot foresee the future. Physical Plant administrators must find a way to prove to educational officers that the building needs of the university will be more completely satisfied if we are provided with a statement of the educational objectives.*[2]

Although the need for an academic plan is recognized by the top administrators of every school of higher education, it is usually difficult and sometimes almost impossible to get even a partial academic plan to aid in master planning and individual building planning. However, a real effort is being made, and now the governing bodies of some schools and school systems require it before approving individual projects. "The Board solicits from each of the presidents of each of the institutions yearly a recommendation as to what one institution wants in the way of an academic or support facility. Also, in what years they will need them. This is supported by the institution's academic program."[3] In fact, at one rather small two-year college, the master plan and some of the projects were held up pending the submission and approval of an academic plan.

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[1] L. A. DeMonte, Architect, "Aspects of Campus Planning," Paper given at the Forty-Eighth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Oregon State University, 1961.

[2] Charles A. Havens, Director of Physical Plant, University of Illinois, Seminar on Planning and Construction, Forty-Seventh Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Massachusetts Institute of Technology, 1960.

No matter how difficult it may be to prepare a meaningful academic plan, a start should be made. As one unidentified campus planner said, "To expect us to plan a building wisely without the benefit of an academic plan to guide us is like trying to construct a building without its foundation." Of course, no one is smart enough to know what changes will be necessary in the years ahead. No building can be planned with any guarantee that radical alterations won't be made in it either. Both the academic plan and the building plan should be developed with the certainty in mind that changes will be required. A statement in the "Academic Plan for the University of California, Davis to 1980," prepared in 1963 by outside consultants and university staff, sums up the need for flexibility:

> *In the pages that follow, predictions will be made in terms that have a ring of finality. These are necessary so that preparations for the future can be made; everything said here, however, will be constantly revised to meet constantly changing conditions. We look forward not to a planned future, but to a constantly planning future. A regular part of each department's and college's business will be to review annually its plans in relation to the total plan and to report to the Chancellor when changes or emphasis appear necessary.*

That statement is well said, and it needed to be said. Any school with a long-range academic plan should review it regularly and keep it functional and up to date, just as its architects and planners are expected to provide functional and up-to-the-minute physical facilities. Any school without an academic plan is to a certain extent relinquishing its academic-planning responsibility to architects and planners and to ad hoc building committees—a perfect case of "putting the cart before the horse."

Because academic planning and physical planning have a direct bearing on one another, there are two items of a physical nature that should be given careful attention in formulating academic plans. One is to secure the maximum utilization of existing space; the other is to allow for the impact that advances in educational media will have on future methods of instruction.

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[3] Frank Durham, Board of Regents, University System of Georgia, "The New Institutional Building—Concept to Contract," Paper given at the Seventeenth Annual Meeting of the Southeastern Regional Association of Physical Plant Administrators of Universities and Colleges, Georgia Institute of Technology, 1968.

**Space Utilization.** Some universities and colleges may have 250 to 300 square feet of academic space per student, FTE; others will have less than one half of those amounts. But one is just as likely as the other to request funds for additional physical facilities each time there is a meeting of their respective funding bodies. How efficiently one school is using its space as compared with another school is difficult to determine, because of the complexities of their many and often quite different functions. However, it is known that some institutions of higher learning seem to get more efficient use of space than others do. Many factors can determine how efficiently or inefficiently space is used. However, considering the cost of building and the financial conditions of many schools, it is good business to be certain that existing space can or cannot house new academic programs before asking for additional facilities. "You can build to accommodate growth which could very nearly bankrupt colleges and universities and make a tremendous dent in the federal budget. I don't think this is the answer. Probably the answer lies more in the possibility that the colleges and universities are going to become more efficient in the use of space than they have in the past."[4]

The following quote is from the excellent report which should be required reading of all school administrators, "To Build or Not to Build, a Report on the Utilization and Planning of Instructional Facilities in Small Colleges." The report is based on research done by John X. Jamrich, assistant dean, College of Education, Michigan State University, and is a report from the Educational Facilities Laboratories, Inc. "The improvement of utilization is not an end in itself. It is simply a means of achieving more efficient use of the educational plant so that money can be saved."

Perhaps a college or a university cannot be operated as efficiently as a profit-making industrial plant, but failing to put existing space to its maximum use before asking for more is certainly not good business. It is doubtful that the faculty should decide whether a new program can be housed in existing space or whether a new facility is needed. Everyone wants to be housed in a new building. It is the first thought that enters the mind when things seem to be getting a bit crowded. It is at this point that a good director of Space Utilization, backed by a small committee of objective staff members, is needed. He should begin by making a real effort to find the needed space. It might mean some doubling up and rearranging of staff and space, but it would be worth a serious try. Then, if it is determined that space is simply not available, a better and more convincing request can be made for a new facility.

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[4] A. H. Bacci and Paul D. McCurry, of the Architectural and Engineering Firm of Schmidt, Garden, and Erickson of Chicago, "Architecture and Building," Paper given at the Fiftieth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, University of Chicago, 1963.

**Educational Media.*** The impact of educational media on education in the past—and it has been great—will likely be multiplied many times in the years ahead. Its potential is so great that no short- or long-range academic plan should be formulated without giving serious consideration to the effect it may have on that plan. Likewise, when the academic plan justifies a new facility, that facility should be planned to make the best possible use of the newest in educational media.

> *Learning media are now far more of the fabric of education and may be employed every time a class meets. With their increased use, and the expanded range and sophistication of methods, the concerns that media impose on educational facilities are far more extensive and significant than ever before. In fact, as this report emphasizes, the optimum utilization of learning media requires conscious planning efforts and the development of new design concepts in educational facilities.*[5]

Whether or not a school has an academic plan, there will come a time when physical planners will be called upon to develop a master plan or provide plans for a single building. In either case, if the school has an adopted long-range academic plan, the physical planners will be able to develop plans that are more likely to stand the test of time. If there is no academic plan, the campus planner, architect, and engineers, working closely with ad hoc committees and the school staff, can develop plans adequate for the present and, hopefully, useful a few years later.

Just as the academic plan should plot the anticipated academic growth of the institution, the master plan should provide the pattern for the orderly development of the Physical Plant. Both plans will require constant updating to enable them to meet the challenges of changing times. But the two plans complement each other so well that the master plan should follow very closely the academic plan.

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* For additional information on instructional technology, *see* chapter 17.

[5] "Educational Facilities with New Media," Published by the Department of Audiovisual Instruction, National Education Association, in collaboration with the Center for Architectural Research, Rensselaer Polytechnic Institute, 1966.

## Physical Planning

**Master Plan.** On college campuses *master planning* is a commonly used term, but far too often that is about the extent of it. In fact, some board members and school administrators seem afraid to see their mental plans for the future of their schools put together on a drawing. Even the term *master planner* seems to conjure in the minds of some the image of a dreamer with his head in the clouds. The purpose of master planning is also commonly misunderstood. Many seem to think that as soon as a building is shown on the plan, they are irrevocably committed to build it. Others who do have a master plan don't use it properly: they have it delineated beautifully, framed behind glass, and hung where visitors can admire it. And there it hangs, year in and year out. This is too bad, because a comprehensive development plan or master plan carefully prepared, properly approved, and correctly used can mean the difference between a disorganized campus and a pleasing, functional grouping of buildings and spaces.

To begin with, the comprehensive master plan should not be considered totally inflexible. One criticism of master plans is that they freeze thinking. "I would like to expose any disadvantage that might originate from a master plan. It is apt to freeze thinking; so that when it develops, it doesn't have advantage of complete flexibility. But this is not too much of a disadvantage."[6] A master plan might be likened to a piece of music: the melody can be retained, but at any time the lyrics can be rearranged or rewritten entirely. If a campus is to grow in an orderly way, many people must first combine their thinking to produce a plan that represents, to the best of their judgments, what the growth of the school will be.

*The building of a great college or university takes more than just the efforts of a group of professional planners. It takes the initiative and enterprise of many people acting individually and in groups. Campus planning is the outward manifestation of this combined effort and has for its aim the determination and development of a desirable physical form and character for the institution. The accomplishment of a plan worthy of this aim takes many years of consistent determination and is a matter not to be taken lightly. The plan is not a map to be hung upon the wall. It is a continual process of integrating physical planning with social and economic improvements. It takes teamwork to accomplish this end. The Physical Plant administrator can play a very important part in this endeavor.*[7]

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[6] Lester Ries, former Director of Physical Plant, Oberlin College, Round Table Discussion on Planning, Thirty-Fourth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Ohio State University, 1947.

[7] Samuel P. Snow, Professor of Landscape Architecture, Auburn University, "An

> *You know there is an amazing similarity in the composition of campuses and cities. Both are environmental entities. There are, of course, good cities and bad ones; and there are good and bad campuses. Why? In a well-organized city, the city manager is in much the same position as a Physical Plant administrator on a campus. The manager is a head man of a team of specialists. The master plans that I have done with which I am most satisfied were in a teamwork situation—one in which the administrator, who had to live with it, knocked together the heads of the physical planners, the architect, and the landscape architect, individually and/or collectively, to produce a balanced result. He insisted on a teamwork setup and on continuing collaborative effort. He had learned that unilateral decisions by particular specialists rarely result in balanced solutions to his problems. Any major change such as a change in the function of a building, a new drive or parking area, will result in a chain reaction through your whole master plan that requires many adjustments to bring it back into balance. Basically, let us say that a good master plan is really nothing more than a guide; but if it lets you know where you want to go, it can be of an inestimable value.*[8]

The master planner must first establish a basic concept of development. As an example, it might be an academic core with a peripheral road around it. Along the outside of the peripheral road could be parking, residence halls, Physical Plant, athletic fields, and other functions that support or complement the academic functions. Inside the peripheral road, or in the academic core, could be academic buildings spaced around blocks of lawns to form quadrangles. Parking and vehicular traffic could be kept to a minimum in this central core. At the proper time, this general concept would be reviewed by all the proper persons and approved. At this point, the "melody" for the development of the campus is largely set. Establishing this concept is the most important single step to be taken in the development of a new campus and should not be taken lightly; subsequent construction should follow that original concept as closely as possible. "It is essential for every institution, educational as well as industrial, to plan for the future in accordance with a predetermined plan. In no other way can planning and construction be done in an orderly and comprehensive manner. Unfortunately, it is true that no plan can be made that will be good for all time; and it must therefore be

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Approach to Campus Planning," Paper given at the Fortieth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Auburn University, 1953.

[8] Sam L. Huddleston, Landscape Architect, Denver, Colorado, "Landscape Planning," Paper given at the Seventh Annual Meeting of the Rocky Mountain Regional Association of Physical Plant Administrators of Universities and Colleges, University of Colorado, 1959.

expected that changes in the plan will become necessary."[9] Buildings shown on the original plan and marked for a specific function may or may not be built to house those functions. The academic plan may have changed in the interim. Certainly the shapes of buildings shown on the master plan will vary as each building architect works out his building plan. So what! The melody is still there. The lyrics are simply being rearranged to satisfy changing conditions. And what is wrong with that? The important thing is to keep the original basic concept and to locate buildings and physical facilities in accordance with it. The shape of the buildings, within limits, and what is housed in the buildings are of minor concern to the master planner.

For a comprehensive development plan to be of most value, it must project itself into the future. It is not unusual to hear an administrator insist, "We are not going to build another building," or "We are not going to take another student beyond a certain figure." College and university buildings are expected to last for at least fifty years, and campuses should last as long as civilization does. When an administration forces its architects and planners to plan so that orderly future expansion is not possible, it will most likely place successors in an untenable position. Just because a few buildings and supporting facilities shown on the master plan go beyond present thinking does not mean that they will necessarily be built. But, if under a subsequent administration they are needed, the campus can expand in a planned and orderly way. In planning a campus, as in most things, it pays to keep a few options open.

The buildings and structures that the master planner arranges on the conceptual plan should be located so that a building such as the library or the learning center will be easily accessible to all, and that buildings housing closely related departments and disciplines will be near each other. Each building should be planned so that it can grow either vertically or horizontally; if the original buildings are constructed too close together, subsequent

A master plan can be of inestimable value in developing a campus if it is logically conceived, has the continuing support of subsequent administrations, and is logically revised and updated as campus programs and requirements are finalized. The following illustrates how a master plan developed for 15,000 students can be enlarged to accommodate 25,000 students and still retain its basic concepts.

Plans 2 and 3 depict how Brigham Young University developed its master plan in 1958 (Plan 2) and how that plan has been refined and updated several times to the 1975 master plan (Plan 3). Notice the many differences between the two, but note also the striking similarities. The 1958 concept has largely been adhered to, and the result is a planned campus that provides an orderly, attractive, and highly functional physical plant for its 25,000 students.

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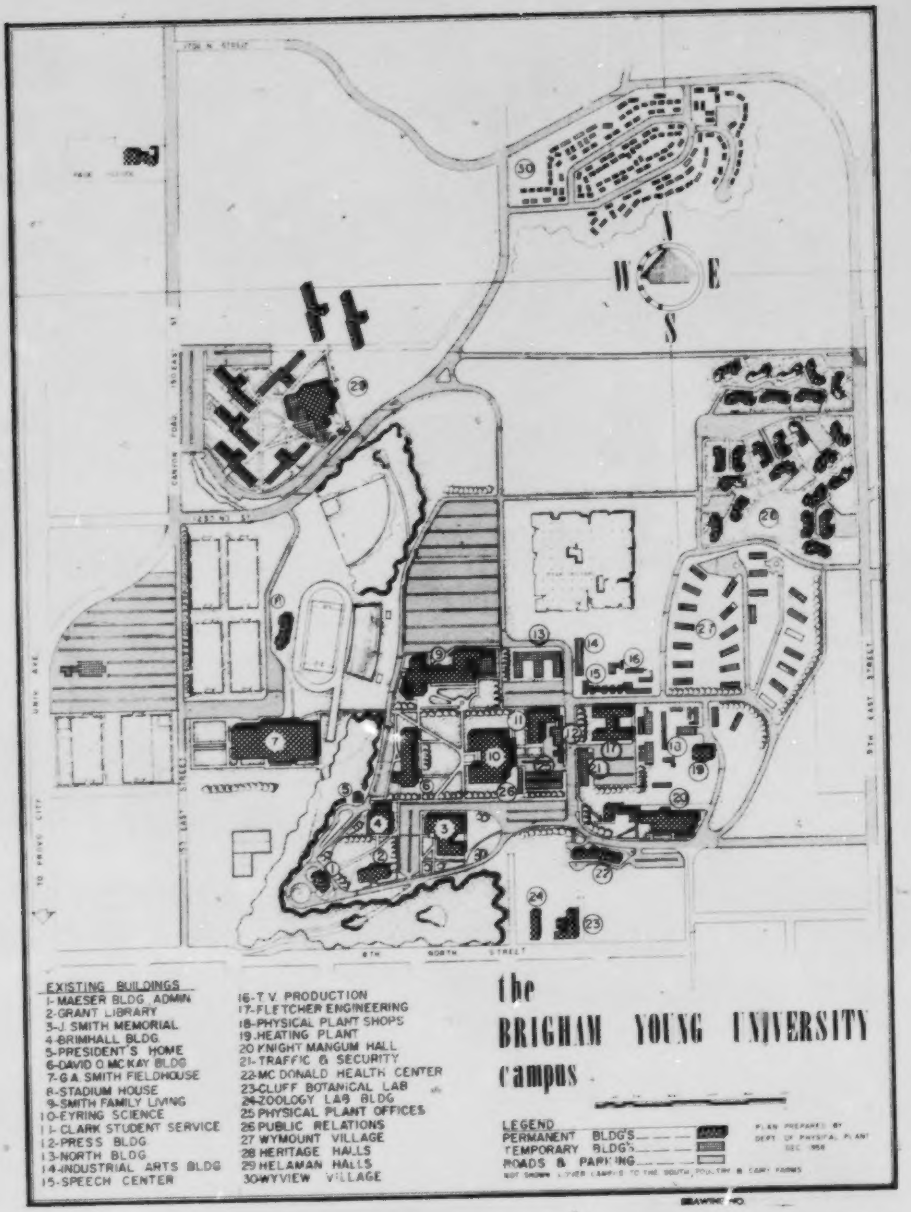
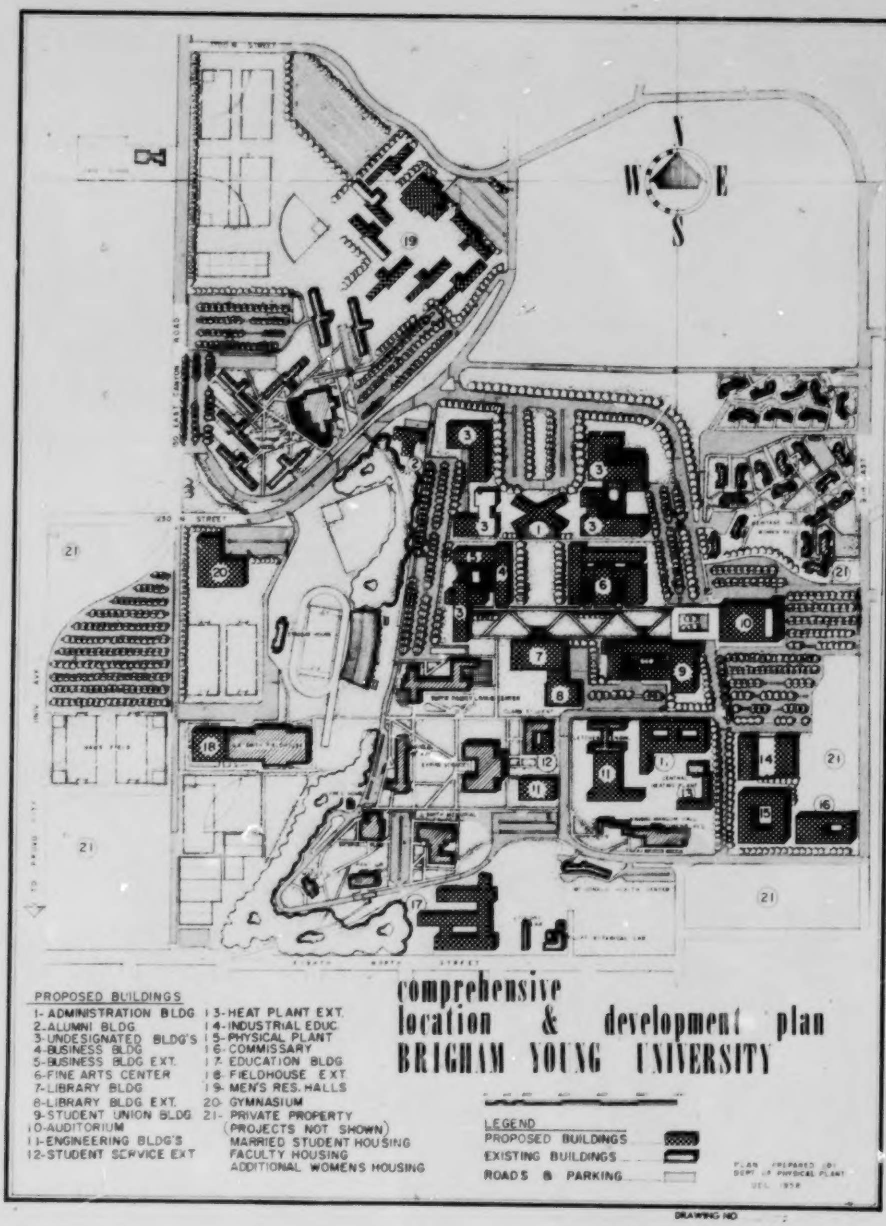
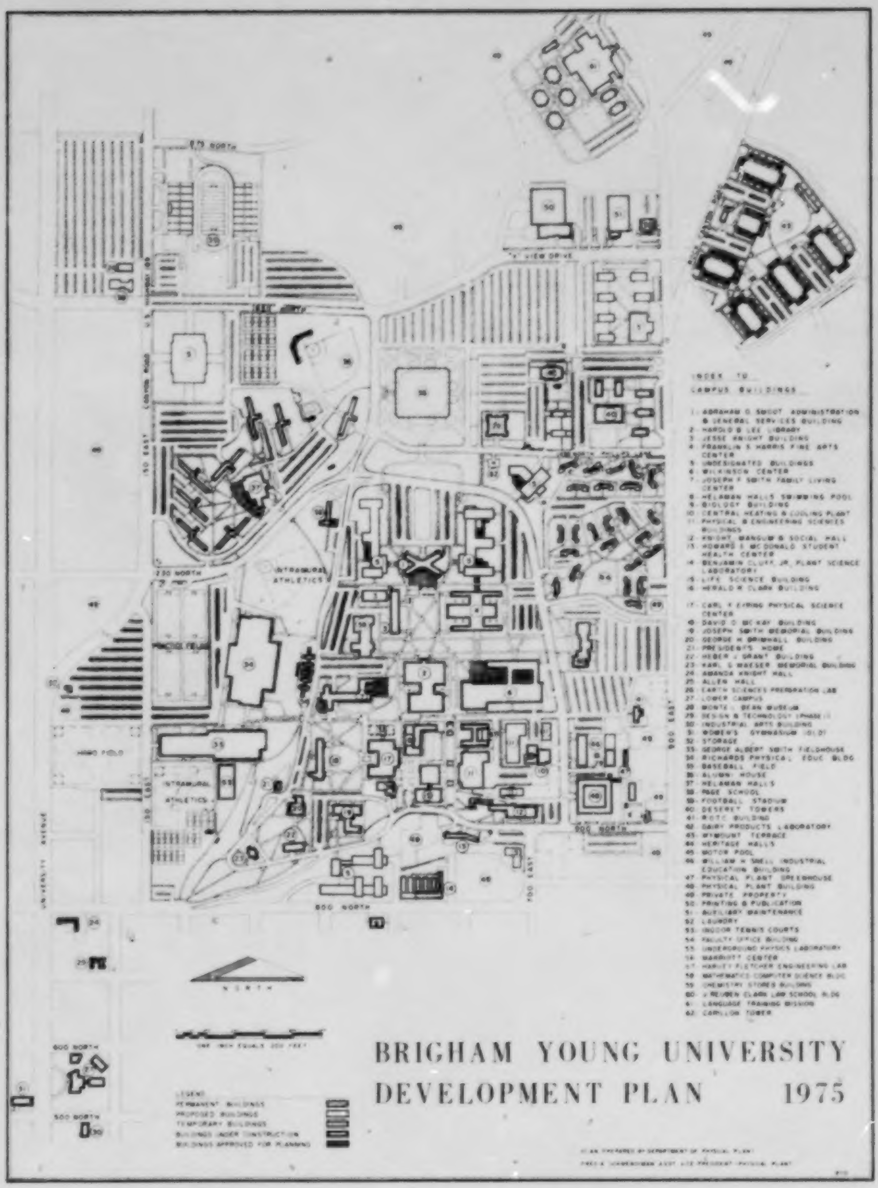
[9] A. F. Gallistel, A.I.A., former Director of Physical Plant, University of Wisconsin, "The Campus Planning Committee," Paper given at the Fortieth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Auburn University, 1953.


N
W
E
S
UNIV AVE
TO PROVO CITY
9TH EAST STREET
8TH NORTH STREET
the
BRIGHAM YOUNG UNIVERSITY
campus
EXISTING BUILDINGS
1-MAESER BLDG ADMIN
2-GRANT LIBRARY
3-J. SMITH MEMORIAL
4-BRIMHALL BLDG
5-PRESIDENT'S HOME
6-DAVID O MC KAY BLDG
7-G A SMITH FIELDHOUSE
8-STADIUM HOUSE
9-SMITH FAMILY LIVING
10-EYRING SCIENCE
11-CLARK STUDENT SERVICE
12-PRESS BLDG
13-NORTH BLDG
14-INDUSTRIAL ARTS BLDG
15-SPEECH CENTER
16-T V PRODUCTION
17-FLETCHER ENGINEERING
18-PHYSICAL PLANT SHOPS
19 HEATING PLANT
20 KNIGHT MANGUM HALL
21-TRAFFIC & SECURITY
22-MC DONALD HEALTH CENTER
23-CLUFF BOTANICAL LAB
24-ZOOLOGY LAB BLDG
25 PHYSICAL PLANT OFFICES
26 PUBLIC RELATIONS
27 WYMOUNT VILLAGE
28 HERITAGE HALLS
29 HELAMAN HALLS
30 WYVIEW VILLAGE
LEGEND
PERMANENT BLDG'S
TEMPORARY BLDG'S
ROADS & PARKING
PLAN PREPARED BY DEPT OF PHYSICAL PLANT DEC 1958
DRAWING NO.

Plan 1. The main university campus as it was in 1958. There were approximately 1,549,000 square feet in permanent buildings and approximately 475,000 square feet in temporary buildings, serving 9,900 students.


N
W
E
S
250 N STREET
EIGHTH NORTH STREET
comprehensive
location & development plan
BRIGHAM YOUNG UNIVERSITY
PROPOSED BUILDINGS
1- ADMINISTRATION BLDG
2-ALUMNI BLDG
3-UNDESIGNATED BLDG'S
4-BUSINESS BLDG
5-BUSINESS BLDG EXT.
6-FINE ARTS CENTER
7-LIBRARY BLDG
8-LIBRARY BLDG EXT.
9-STUDENT UNION BLDG
10-AUDITORIUM
11-ENGINEERING BLDG'S
12-STUDENT SERVICE EXT
13-HEAT PLANT EXT.
14-INDUSTRIAL EDUC
15-PHYSICAL PLANT
16-COMMISSARY
17- EDUCATION BLDG
18- FIELDHOUSE EXT
19- MEN'S RES. HALLS
20- GYMNASIUM
21- PRIVATE PROPERTY
(PROJECTS NOT SHOWN)
MARRIED STUDENT HOUSING
FACULTY HOUSING
ADDITIONAL WOMENS HOUSING
LEGEND
PROPOSED BUILDINGS
EXISTING BUILDINGS
ROADS & PARKING
PLAN PREPARED BY DEPT OF PHYSICAL PLANT
DEC. 1958
DRAWING NO

Plan 2. The master plan as approved in December 1958. At that time it was envisaged that the enrollment would not exceed 15,000.


BRIGHAM YOUNG UNIVERSITY
DEVELOPMENT PLAN 1975
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5. UNDESIGNATED BUILDINGS
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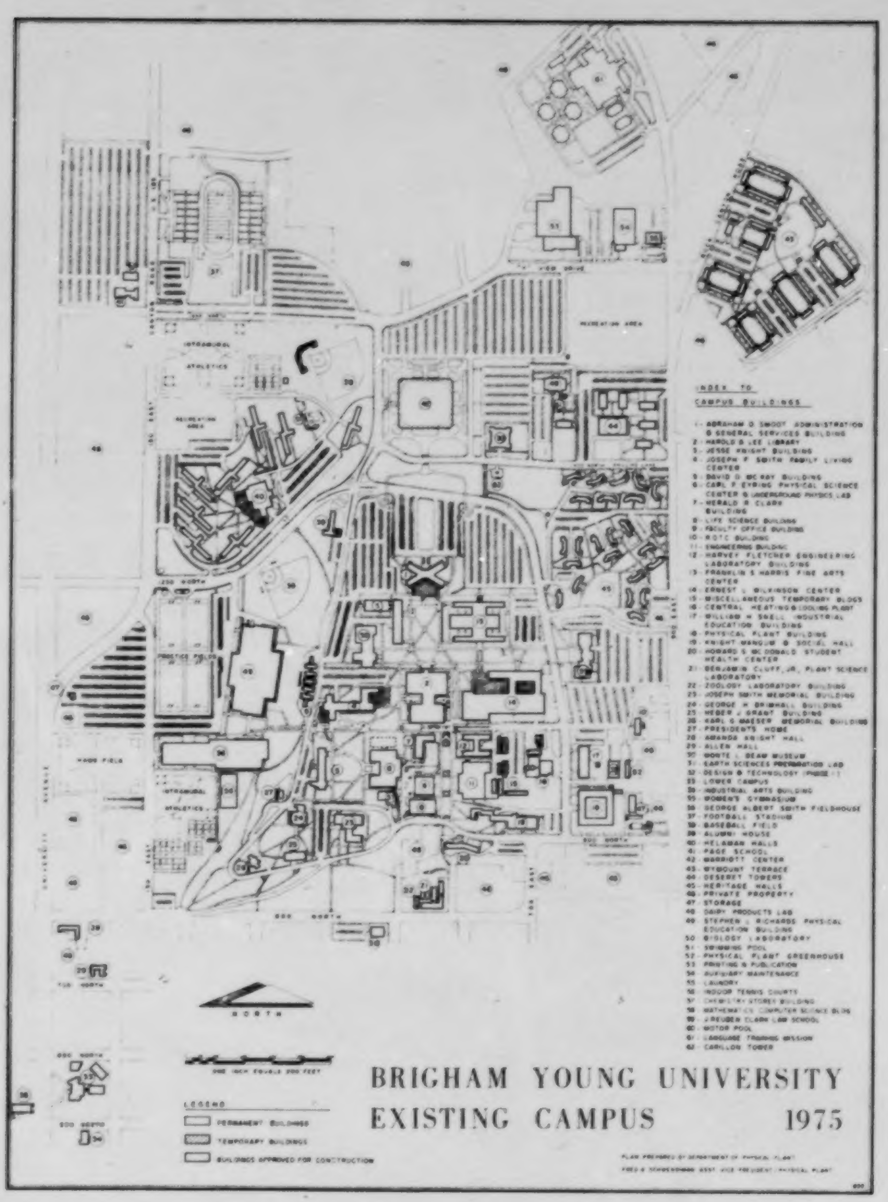
19. JOSEPH SMITH MEMORIAL BUILDING
20. GEORGE H. BRIMHALL BUILDING
21. PRESIDENT'S HOME
22. HEBER J. GRANT BUILDING
23. KARL G. MAESER MEMORIAL BUILDING
24. AMANDA KNIGHT HALL
25. ALLEN HALL
26. EARTH SCIENCES PREPARATION LAB
27. LOWER CAMPUS
28. MONTE L. BEAN MUSEUM
29. DESIGN & TECHNOLOGY (PHASE I)
30. INDUSTRIAL ARTS BUILDING
31. WOMEN'S GYMNASIUM (OLD)
32. STORAGE
33. GEORGE ALBERT SMITH FIELDHOUSE
34. RICHARDS PHYSICAL EDUC. BLDG
35. BASEBALL FIELD
36. ALUMNI HOUSE
37. HELAMAN HALLS
38. PAGE SCHOOL
39. FOOTBALL STADIUM
40. DESERET TOWERS
41. ROTC BUILDING
42. DAIRY PRODUCTS LABORATORY
43. WYMOUNT TERRACE
44. HERITAGE HALLS
45. MOTOR POOL
46. WILLIAM H. SNELL INDUSTRIAL EDUCATION BUILDING
47. PHYSICAL PLANT GREENHOUSE
48. PHYSICAL PLANT BUILDING
49. PRIVATE PROPERTY
50. PRINTING & PUBLICATION
51. AUXILIARY MAINTENANCE
52. LAUNDRY
53. INDOOR TENNIS COURTS
54. FACULTY OFFICE BUILDING
55. UNDERGROUND PHYSICS LABORATORY
56. MARRIOTT CENTER
57. HARVEY FLETCHER ENGINEERING LAB
58. MATHEMATICS-COMPUTER SCIENCE BLDG
59. CHEMISTRY STORES BUILDING
60. J. REUBEN CLARK LAW SCHOOL BLDG
61. LANGUAGE TRAINING MISSION
62. CARILLON TOWER
LEGEND
PERMANENT BUILDINGS
PROPOSED BUILDINGS
TEMPORARY BUILDINGS
BUILDINGS UNDER CONSTRUCTION
BUILDINGS APPROVED FOR PLANNING
NORTH
"Y" VIEW DRIVE
INTRAMURAL ATHLETICS
PRACTICE FIELD
INTRAMURAL ATHLETICS
800 NORTH
900 EAST
700 EAST
150 EAST
UNIVERSITY AVENUE
600 NORTH
500 NORTH

Plan 3. The master plan updated to 1975.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32 - DESIGN & TECHNOLOGY (PHASE I)
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35 - WOMENS GYMNASIUM
36 - GEORGE ALBERT SMITH FIELDHOUSE
37 - FOOTBALL STADIUM
38 - BASEBALL FIELD
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59 - J REUBEN CLARK LAW SCHOOL
60 - MOTOR POOL
61 - LANGUAGE TRAINING MISSION
62 - CARILLON TOWER
NORTH
ONE INCH EQUALS 200 FEET
LEGEND
PERMANENT BUILDINGS
TEMPORARY BUILDINGS
BUILDINGS APPROVED FOR CONSTRUCTION
BRIGHAM YOUNG UNIVERSITY
EXISTING CAMPUS 1975
PRACTICE FIELDS
INTRAMURAL ATHLETICS
RECREATION AREA

Plan 4. The campus as it was in 1975. The physical plant (1976) contains more than 6,000,000 square feet, and the student enrollment is fixed at 25,000.

expansion will force colleges, departments, and disciplines to leapfrog each other. And that is not good. John Dozier, business manager of Duke University, stated, "The vitality, imagination, and philosophy of a university can to some extent be measured by the concepts of the campus master plan and the quality of the individual buildings."

In fairness, not all campus planners accept master plans in the favorable light that they are being presented in here. Some feel strongly that master planning is the wrong approach, that it is better to let the campus develop in accord with what is expedient at any given time. They can cite many examples of money being spent on a succession of master plans and nothing really worthwhile being accomplished. Many master plans developed by professionally recognized consultants have been followed only partially or perhaps not at all. One important reason for their failure was a lack of general acceptance; but mostly they failed because no one bothered to keep them updated. The person who prepared the *plan* collected his money and left to prepare another plan for some other school. To prevent this waste, someone in a strong position on the school staff must (1) see that the plan is seriously considered when decisions are being made affecting the physical development of the campus and (2) see that the plan is redrawn and kept updated. Otherwise, the master plan will soon be just another item in the school archives. It is better to revise an existing master plan periodically than to try developing an orderly campus with a succession of different plans. Adhering inflexibly to a predetermined plan is not a perfect solution to the problem of developing an orderly and functional campus over many years, but a planned campus, even though not perfect, is better than one allowed to develop at the whims of whoever is in charge at any particular time. "One of the most important aspects of any master plan is its ability to meet the forces of change."[10]

A comprehensive development plan should not be just a pretty picture. It should also be a working tool. To be of any use, it must be prepared to serve the present and, so far as possible, the future mission of the school. It must be more than a plan of bilateral symmetry so beautifully delineated in line and color that it more closely resembles a painting than what it should be: another working drawing. By all means have one or more nicely rendered in color to hang in suitable places, but have the same plan on a linen tracing so that copies can be made as needed. Some of these copies may be colored with pencil or pastel and spotted around the campus in less prominent places than the original. For example, copies should definitely be in the offices of the chief campus planner and the director of Physical Plant and in the meeting room of the Campus Planning Committee. A copy should be referred to whenever discussions are held regarding new physical facilities.

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[10] Francis T. Taliaferro, A.I.A., Partner in Rogers, Taliaferro, Kostritsky, Lamb, Architects, Planners, Baltimore, Maryland, "Planning Procedures for New or Expanding Campuses," Paper given at the Fifty-Sixth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, University of Maryland, 1969.

Actually, there should be two plans. One plan, at the same scale as the master plan, should show the campus as it was at the time the master plan was prepared. Right beside this, in the planning rooms, should hang the master plan.

After the academic- and master-planning concepts are developed, they should be approved by the Board of Trustees. Care should be taken to see that the master plan does not cause values to increase on land that the school would like to acquire. F. D. Chaffee, former superintendent and assistant business manager at Springfield College, Springfield, Massachusetts, stated that problem well: "A concrete example of a disadvantage of the master plan at Springfield was that when the master plan was developed, it showed a beautiful campus including land we did not own but hoped to have someday. As soon as this was known, the price of nine privately-owned houses around the campus jumped in price."[11] When it becomes necessary to plan for the future growth of the school on ground that the school does not own, it may be necessary to have two plans—one for general display and everyday use, and the other kept under cover until the land is acquired.

It is not only possible but probably desirable that the master plan be prepared by the campus planner and his staff with the help and support of outside consultants as needed. There are architects, landscape architects, and specialists in campus planning who are perfectly capable of assisting the school planners or in doing a campus master plan if given the right assistance by school personnel. Subsequent redrawings of the master plan can easily, and logically, be done by personnel in the planning office. Between redrawings, all the suggestions for changes to be made at the next revision should be kept under file so that nothing will be overlooked in keeping the plan in harmony with the growing, expanding, ever-changing school.

Preparing a comprehensive development plan for the growth of a new institution, or for an old institution on a new site, is far easier than preparing one for an institution that has grown haphazardly without the benefit of long-range thinking and planning. Even in the worst cases, however, it is not too late to start. Very definite progress can be made in a few years, when campus development begins to follow a predetermined plan. Some master planners may have their heads in the clouds, and not all master plans are good; but a good planner and a good master plan can do some pretty wonderful things for any campus if given a fair chance.

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[11] F. D. Chaffee, Former Superintendent and Assistant Business Manager, Springfield College, "Planning," Paper Given at the Thirty-Fourth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Ohio State University, 1947.

**Utilities Plan.** Perhaps of equal importance to the campus master plan is the campus utility plan. The great majority of people who walk or drive on a university or college campus would be amazed if they knew how many pipes, conduits, and underground services they were crossing. Two Physical Plant directors were discussing their campuses and one said, "We have so many underground utilities that it is impossible to stick a pick in the ground without hitting one of them." The other one replied, "Yeah, at my school it's so crowded underground that the night crawlers have been forced to move off campus." Both men exaggerated slightly, but they made the point that there are a lot of essential services on a campus the public seldom sees.

A campus is a highly complex and concentrated community. It requires all the services that a sizable city would require. Because the appearance of a campus is so important, most of its utilities are underground—or should be. Of course, they all surface at many points, so the entire utility distribution system becomes extremely complicated and expensive. There are steam lines, condensate return lines, chill-water lines, electrical-distribution systems, gas lines, storm and sanitary-sewer lines, water pipes, telephone lines, low-voltage lines, fire-alarm systems, lawn-sprinkling systems, wires for central-control systems, and large walk-through tunnels. Probably there are more, but that is enough to introduce the problem.

Some campuses have extensive tunnel systems containing many utilities. Others have a partial tunnel system and the rest of their utilities buried. Some schools have no tunnels; all utilities are either buried or run overhead. As an example of how extensive just one part of a utility distribution system can be on a large campus, Ronald T. Flinn reported, "Michigan State University has 34.4 miles of steam and condensate return pipes and this system includes 5.0 miles of walk-through steam tunnels. The tunnels carry steam pipes varying from 2 1/2" to 30" in diameter, and accompanying condensate return lines vary in size from 1" to 18" in diameter. The steam tunnels have been constructed with various widths and heights, but the most common have inside dimensions of 6'-9" width and 6'-2" height."[12] Even Mr. Flinn would not be able to state accurately how many hundreds of miles of pipe, wire, and conduit are on the campus. A smaller school would have the same types of services that a big school has, but it wouldn't have so much. Dr. Robert Hutchens, when he was president of the University of Chicago, was credited with saying that, "A university is a collection of buildings hooked together by a steam line."

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[12] Ronald T. Flinn, P.E., University Engineer, Michigan State University. "Walk-Through Steam Tunnels at Michigan State University," Paper given at the Fifty-Eighth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, University of Arizona, 1971.

On a new campus, preparation of the master utility plan should be started by engineers as soon as the master development plan is fairly well established. It is essential that all utilities be located so as to not be in the way of excavations for buildings but near enough to serve them. As roads and streets are developed, conduits should be placed under them at suitable places to take care of telephone cables, electric wiring, water lines, and the like that will be needed at a later time. It is always good planning to install a few spare conduits for unexpected future needs. That way, streets won't be cut and patched quite as often. Pipe sizes must be carefully studied so that future requirements can be met. If in doubt, put in larger sizes: the only additional cost will be in increased pipe sizes. Later it will be that plus labor and much inconvenience. All this and much more should be part of the campus utility plan. If utilities are constructed in accordance with both the master plan and the utility plan and a building is not constructed in its proposed position but is moved or shifted, there could be considerable expense incurred in rerouting or extending or in providing new services. The process can be not only expensive, but also time consuming and even embarrassing. The point is that on a newly developing campus, great care should be exercised to see that the master development plan and the master utility plan are coordinated, reviewed, and officially approved before the start of construction.

Before engineers can do very much in the way of detail planning, the school staff must make many important decisions with the help and advice of their engineering consultants. They must answer such questions as these: Will the campus buildings be heated by steam, high-temperature water, or electricity? Will the buildings be individually air conditioned, or will there be a central chill-water system? Will the school purchase all its electricity from an outside source, or will it generate all or part of it on campus? Can the school supply all or part of its water, or must it purchase water from the local municipality? Will all utilities be underground, or can some be on poles? Will there be a tunnel system; if so, to what extent? If some direct burial cable is to be used, what kind is best? These questions and many more, such as those related to energy conservation, must be answered. How well they are answered and how efficiently the details are developed will affect the comfort, the convenience, and the pocketbook of countless people for many years. The best advice is, "Get started early; don't rush it; and don't be 'penny wise and pound foolish.' " A little extra money spent in the beginning to do it right will be a wise investment. At their best, utilities are expensive; but inadequate and malfunctioning utilities are the most expensive of all.

On an existing campus, and especially an old one, there will be pipes, conduits, clean-outs, valves, and so on about which the Department of Physical Plant has no records. As-built drawings have not always been provided; and even when they have been, they are not always complete or accurate. It is a serious matter to have a high-pressure waterline burst in the middle of a cold night. It is even more serious when everyone is running over everyone else trying to find a cut-off valve that will stop the flow of water. Every school should have record drawings showing the exact location, size, direction of flow, type, and all other information pertaining to its utilities. That is easy to say, and difficult to do. On older campuses, much of the underground utilities system has been done by persons no longer available to provide information. Sometimes the failure of a utility will provide information as to its location. However that information is obtained, it should be plotted immediately on record utility drawings; and prints of those drawings should be kept where maintenance people have ready access to them at any hour of the day or night. Getting and keeping such information is not a job that an employee should be assigned to do when he has nothing else to do. It is too important for that. Any school that hasn't already plotted its utilities should do so as soon as possible. The first step might be to assign a draftsman in the planning office to do the actual plotting on standard sheets at some convenient scale, such as 1" = 40'. A start can be made by carefully checking the building plans and utility plans on all completed projects. As-built drawings should be helpful. Perhaps 50 percent of the needed information can be obtained that way. The rest will come harder, and over a long period of time. "Old timers" who remember when certain things were done and where will provide some of that remainder. Physical Plant personnel who daily work with and service the utilities will provide a lot of information. The last bit will come, as mentioned before, when some unknown part of the total system fails and has to be replaced.

Most schools with sizable building projects have had to reroute extensive underground or overhead utilities to get them out from under or away from a building that has taken a different shape or been placed in a location different from that anticipated when the utilities were originally installed. There is perhaps no way to insure that this won't happen occasionally, but it isn't as liable to happen where campus buildings are being located in accordance with a carefully prepared and coordinated master plan and master utility plan.

The larger universities and colleges will have on their staffs mechanical and electrical engineers who can supervise the operation of utilities and can do some of the design work needed on extending, upgrading, altering, or rerouting utilities. But even at the bigger schools it will be advisable on larger and more complicated jobs to bring in engineering consultants. There is too much at stake to take any unnecessary chances. The smaller schools with correspondingly smaller staffs will rely more heavily on engineering consultants for operating advice and design work. The thing to watch is not to get so many different individuals or firms involved that an uncoordinated system of utilities will result. Different individuals and different firms might have different ideas. Each might do the total job really well, but all working separately and at different times might produce less-than-desirable results. There are firms that have years of experience in working with colleges and universities on their engineering and utilities problems. Such firms would accept responsibility, and virtually any one of them would be a good choice. The design of extensive heating and air-conditioning systems is a complicated business, and even the best in the business will make an occasional mistake. One Physical Plant director indicated that he had used the same engineering firm for years. When asked if the firm made mistakes, he replied, "Oh they make quite a few." When he was asked, "Why do you keep using them?" he replied, "Because it is the best firm we know of." Knowing that mistakes in design and construction of utilities may occur requires that every precaution be taken to minimize errors. A good engineering consultant or engineering firm, working closely with a capable and experienced Physical Plant staff, is as good a guarantee against errors as can be obtained.

## Summary

Academic planning must precede physical-facilities planning if good and lasting results are to be obtained. Existing space should be used to its maximum before new space is requested. To obtain maximum use, space-utilization studies must be kept current. School administrators should be able to prove without a doubt that space is not available before requesting new space. Curriculum additions should not be approved until space requirements needed for the additions are known to be available.

Master planning should follow careful academic planning. To be effective, a master plan must *not* be inflexible. It must be revised from time to time, but its basic pattern should be maintained insofar as is possible. A master plan is more likely to be effective if it is developed and maintained by a competent school-planning staff rather than by outside consultants.

Utilities represent a sizable percentage of the physical facilities dollar, both in original cost and in maintenance and operation. On a newly developing campus the preparation of a master utility plan should be started as soon as the master development concept is fairly well established. On an existing campus as-built drawings should be maintained on all utilities to aid in maintenance and to provide information for needed future additions.

# 3

# Planning Projects

After years of waiting and hoping, authorization has finally been received allowing planning to start on that badly needed and long-overdue building. Now that approval for planning has been received, much work must be done before approval can be obtained to solicit bids for construction. How well that work is done will to a large extent determine (1) how much the building's original cost will be, (2) how well it will serve its occupants over a span of many years, and (3) how much the cost of maintenance and operation will be over those years.

Often the tendency at this point is to move ahead rapidly, cut as many corners as possible, and get construction started at the earliest possible moment. No matter that the school has survived for years without the building or that it should serve the school for 50 to 100 years after it is built. The urgency is now so great that the time for planning and, hopefully, for construction must be reduced to the minimum. Pressure is put on everyone concerned. "Let's get an architect and get started!" "What are we waiting for?" "Time is moving, so why should it take so long?" *That line of thinking is understandable, but it is probably the poorest way to begin a project.*

The average university building is too complex, and there are too many people involved, to permit much "corner cutting." In the design of such buildings, haste can cause waste.

*Another element which plagues the administrator and the architect is the 'time factor.' Architects feel that few clients appreciate how long it takes to* *do things properly. They [architects] also realize that time spent in planning is not waste time—it is time which avoids major blunders and makes for a satisfactory programme. . . . The architect cannot perform to advantage in the absence of an accepted programme.*[1]

But the client is right, too. Excessive time can cost money. The best answer is to move ahead as rapidly as possible but at a speed that will allow for thorough academic planning (programming) and for good architectural and engineering design. To do these things and do them right is time consuming, but time can be saved when the school staff can quickly agree on what is needed and can produce a program of those needs so that the architect can spend his time producing plans. Ad hoc planning committees who debate endlessly over what is needed or how facilities are to be used, and who are too busy to meet regularly can easily use up twice as much time as they are willing to allow the architect for developing a complete set of contract documents. The end results of such a procedure will probably be (1) a program no better than it would have been if efficiently developed in one-half the time and (2) a set of poorly coordinated plans and specifications far inferior to what the architect and his engineers could have produced if they had not been forced to make up the time lost by the committee.

### Programming

This subject could be enlarged to discuss programming for the development of an entire campus, but here the subject will be restricted to a discussion of why and how to prepare Programs of Requirements for individual building projects. There are hundreds, perhaps thousands, of architectural firms who possess the skill, artistic judgment, and technical know-how to design university and college buildings. The same is true of mechanical, electrical, and structural engineers. The problem is to design structures that will serve adequately the complex uses that will be made of the buildings by the many specialists who will use them.

*No matter how good the architect or engineer may be, he cannot know and should not be expected to know how to plan a building to serve a large number of specialists without considerable help and assistance from the 'specialists-clients' themselves. Thus, the real problem is how to transmit literally hundreds of messages from the university staff to the architect conveying the staff's wishes, needs, likes and dislikes, interests, theories,*

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[1] C.F.T. Rounthwaite, Architect, "Ideal Relationships Between the Architect and Physical Plant Personnel," Paper given at the Fifty-Fourth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Université de Montréal, 1967.

*problems, and a multitude of other items in such a way that they can eventually be translated satisfactorily into an architecturally pleasing and functionally satisfactory building. The better this transmission of information is accomplished from the university staff to the architect and his engineering associates, the better the building will serve its purpose. The success of a building project, and the owner's satisfaction, may well be determined by how successful the transfer of need and intended use by the owner is made to the architect.*[2]

*Most of the graphics that architects develop begin with the appointment of a contract architect who is then charged with developing all of the basic front-end of the total project. My experiences and my judgment cause me to have a different approach. I prefer that the front-end of a project be done in-house before an architect becomes involved. Certainly, there has to be a judicious point at which this development does bring in an architect because it could be a disaster to develop a project so far that some of the architectural prerogatives are usurped. At any rate, I think that anyone with even nominal experience could make a better selection of an architect if some of the preprogramming work had already been accomplished before the selection was made. I like to think in terms of bringing an architect into a project to meet a specific objective. It seems to me that it would be hard to do that if he entered the project before the specific objective was defined.*[3]

There are various ways of working with the architect during the important early planning stages. A method too often used is to have the architect talk to a score of people, making notes and asking questions until he begins to "get the picture." Then he prepares plans and a perspective, beautifully delineated in color, and mounted in a frame. Armed with these, the architect then meets with the designated university officials and points out all the good features of his plans. The bad aspect of this method is that the owner may end up with a beautiful building but one that lacks those details that will become so important starting with the day that the building is occupied. The reason for this situation is generally that the users of the building themselves have not given as much thought as they should to how they will use the facility. Of course, the conscientious architect will spend many days trying to procure from his clients the information he needs for designing a functional building; but he must produce plans if he is to make money, and there is a limit to the research he can afford to do.

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[2] Sam F. Brewster, Director of Physical Plant (retired), Brigham Young University, "Programming, Planning, and Construction of College and University Buildings," Paper given at the Fiftieth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, University of Chicago, 1963.

[3] Harry F. Ebert, Director of Physical Plant, Rice University.

Where the talent is available, the owner may use another method: producing sketches and drawings of what is wanted to give to the architect. However, this method has a tendency to freeze thinking and to force the architect into adopting predetermined forms and shapes. Nor does this method afford the architect as much information as he should have on scores of functional details. But, sketches and drawings do have merit when they are used to supplement a carefully detailed written program.

Another method is for the owner, working through the ad hoc building planning committee, the Campus Planning Committee, and the school planning office, to prepare a written program. The preliminary program can be, and often is, prepared before the architect is selected. Experience has shown, however, that it is wise to involve the architect after the program is developed in preliminary form. This is the stage at which the architect, a member or members of the ad hoc committee, and a member or two from planning or Physical Plant could very wisely visit a few schools where buildings similar to the one being programmed have recently been constructed. If such a visit is properly conducted, and a trip report prepared, it can pay for itself several times over. After the trip has been completed and the preliminary program has been revised as a result of the visit, it should then be discussed in detail with the president of the university and with his Administrative Council. It is here that policy questions are finally resolved and a university-wide acceptance of the project is obtained. After this meeting or meetings, final changes and corrections can be made and a copy of the written program bound for each person concerned.

The University of Maine has seven campuses in its system. The following is a brief statement of how they handle programming:*

*We call the written program for any major project the 'Conceptual Plan' for that project. Prior to the writing of the Conceptual Plan, very brief programming studies have been undertaken to ascertain the approximate size and nature of the project to be used when evaluating any project against others with respect to requesting funds for construction. At about the time the decision is made to seek funds from the state for the project, we advocate beginning the conceptual planning phase. Campus members of the Building Committee generally include: Dean of the College, possibly the Academic Dean, several faculty persons who are most knowledgeable of the programs which the building will serve, the campus Director of Physical Plant, a mem-*

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*For more detail see "Planning and Construction at the University of Maine," in Appendix B.

*ber or members of the Campus Planning Committee, a representative from the campus Engineering Office if such exists, and often times, representatives from the student body. On the smaller campuses, the president will quite often involve himself as a member of the committee. During the Conceptual Planning Phase, this large number serving on the committee is very effective in bringing to the committee all of the various inputs which it is desirable to consider. At a point, however, we recommend that the committee be reduced in size for a final consolidation of inputs into the Conceptual Plan for the facility. Generally speaking, this reduced committee will then serve as the Building Committee which will meet with the architects during the design phases.*[4]

Walter W. Wade, Director of Physical Plant, Purdue University, states, "The Facilities Planning Section of the Physical Plant Department coordinates the preparation of programs prepared by a committee from the school for which the facility is being built. A committee member works with Facilities Planning personnel in working with the architect."[5]

Frank A. Kopf, Director of Physical Plant, State University of New York at Albany, writes, "The Facilities Program Coordinator, responsible to the Director of Physical Plant, coordinates many aspects of the project through to its completion. Participants are individuals appointed by deans and chairmen of units which will occupy the facility. Program format is standardized state-wide."[6]

Robert L. Siefort, University Architect, Michigan State University, writes: "State funded projects require state approval of Program, Schematics, and Preliminaries. Self-liquidating projects require legislative concurrence."[7]

In preparing a program of requirements for a building, attention should be given, not so much to the shape or form that the building will take, as to its size, use, and special requirements and to special features desired in the various components that, taken together, will form the building. Budget limitations, if any, must also be given serious consideration at this time. All this means that those working on such a program must know how they intend to use the building. Furthermore, having to prepare a detailed written program in advance of planning has a good effect on the future users of the building. To get approval of their proposals, they must demonstrate that they have clearly in mind how they intend to use their future facilities, and this in turn requires that they organize their thought and procedures. The ultimate benefit is a better, more functional building.

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[4] Richard A. Eustis, Director of Physical Facilities, University of Maine, Response to Author's Questionnaire on Planning and Construction, 1975.

[5] Walter W. Wade, Director of Physical Plant, Purdue University, Response to Author's Questionnaire on Planning and Construction, 1975.

[6] Frank A. Kopf, Director of Physical Plant, State University of New York at Albany, Response to Author's Questionnaire on Planning and Construction, 1975.

[7] Robert F. Siefort, University Architect, Michigan State University, Response to Author's Questionnaire on Planning and Construction, 1975.

When such information is available at the very beginning of a project, the architect can start to work immediately. Because he does not have to spend time attempting to dig out this information for himself, he can spend more time on his schematic drawings and can therefore give the owner a greater selection of schemes to study and choose from.

To accomplish the most satisfactory and worthwhile programming, a person or persons in the school planning office trained in the technique of programming should work closely with the project committees to produce documents that reflect the desires and needs of the future users in such a way that the architect and his engineers can quickly gain an understanding of what is wanted.

There are nearly always budget restrictions, so no final program of requirements for a project should be submitted to the school administration for consideration and approval without a carefully prepared estimate of cost. The estimate should be prepared in cooperation with the architect and his engineers. Once the program and the estimate of cost are approved by the administration and agreed to by the architect, the architect should make every effort to produce contract documents that can be successfully bid within the estimate. The following is an example of how an estimate can be prepared to reflect both the contract cost and the project cost:

Estimated Cost of Project
(for a Hypothetical Building)

| | |
|---|---|
| 200,000 Gross Square Feet @ $40.00 (contract cost) | $8,000,000 |
| Architectural Fees @ 6% | 480,000 |
| Administrative Costs | 60,000 |
| Extension of Utilities | 75,000 |
| Soil Tests | 3,000 |
| Building Permit | 5,000 |
| Insurance @ $.15 per $100 | 12,000 |
| Site Development and Landscaping | 100,000 |
| Furniture and Equipment | 550,000 |
| Moving and Occupancy Costs | 20,000 |
| Contingency @ 5% | 465,250 |
| Estimated Project Cost (if built in 1974) | $9,770,250 |
| Estimated Contract Cost per Square Foot in 1974 | $40.00 |
| Estimated Project Cost per Square Foot in 1974 | 48.85 |

| | |
|---|---|
| **Estimated Contract Cost per Square Foot in 1975 (escalated 6%)** | 42.40 |
| **Estimated Project Cost per Square Foot in 1975** | 51.78 |

Experience has shown that it is well to include a "Certification Statement" signed by members of the ad hoc committee and by others who had an active part in preparing, reviewing, and approving the program. Approvals in writing at this stage seem to reduce much of the second guessing and criticism that often occur at a later date. The following is an example of such a certification as used at Brigham Young University:

> We hereby certify that we have compiled the following information concerning the space requirements in the Engineering Building, that the utilization of each room and facility, based on present authorized courses for a student body of 25,000 has been checked by us and is certified by us to be correct for those phases of the college programs as indicated in the facility descriptions:

Engineering Building Committee

| | |
|---|---|
| Committee Chairman, and Civil Engineering Department Chairman | Chairman, Mechanical Engineering Department |
| Chairman, Chemical Engineering Department | Chairman, Electrical Engineering Department |
| Dean, College of Physical and Engineering Sciences | Director, Physical Plant Department |
| Chairman, Engineering Analysis Center | Chairman, Campus Computer Committee |
| Student Representative | Academic Vice-President |

Schools that have been using written programs have undoubtedly worked out their own method of preparing them. Thus, there are many ways to prepare a Program of Requirements, and it would be difficult to say which of the many methods is best. Because a program for a major building could run from 50 to 200 pages, it is obviously impractical to reproduce a complete program here. However, the following sample pages should serve to indicate the amount of detail a good program contains. Such detail will better enable the architect to tailor his building to the users' requirements.

The Table of Contents of the Program of Requirements might be something like the following (used for the Law Building at Brigham Young University):

Page

Introduction . . . . . 5
Certification . . . . . 6
Space Requirements . . . . . 7-8
Estimated Costs . . . . . 9
Special Considerations . . . . . 10
  Map of Campus . . . . . 11
  Location of Building . . . . . 12
  Materials Specified . . . . . 12
  Air Conditioning . . . . . 12
  Elevator . . . . . 12-13
  Mail Room . . . . . 13
  Loading Dock . . . . . 13
  Ceiling Height and Construction . . . . . 13-14
  Facilities for the Handicapped . . . . . 14
  Clocks and Class Bells . . . . . 14
  Coat Racks . . . . . 14
  Location of Functions within the Building and
    Provision for Future Addition . . . . . 14-15
  Acoustics . . . . . 15
Room and Facility Descriptions . . . . . 16
  Dean's Office . . . . . 17
  Administrative Offices . . . . . 18
  Secretarial Office—Dean . . . . . 19
  Public Service and Reception Area . . . . . 20
  Secretarial Work Room . . . . . 21
  Conference and Council Room . . . . . 22
  Faculty Offices . . . . . 23-24
  Teaching Assistant Offices . . . . . 25
  Typists' Rooms—Faculty . . . . . 26
  Student Organization Office Stations . . . . . 27
  Student Organization Work Areas . . . . . 28
  Spare Office . . . . . 29
  Justification for Lecture and Related Rooms,
    Facilities 13 to 21 Inclusive . . . . . 30
  Lecture Room . . . . . 31-33
  Moot Court and Lecture Room . . . . . 34-35
  Lecture Room . . . . . 36-37
  Lecture Room . . . . . 38-39
  Lecture Room . . . . . 40-41
  Lecture Room . . . . . 42-43
  Lecture Room . . . . . 44-45
  Seminar Room . . . . . 46
  Student Common Room . . . . . 47
  Book Collection . . . . . 48
  Reserve Book and Controlled Study Area . . . . . 49
  Group Study Table—Space Requirements . . . . . 50
  Individual Study Table—Space Requirements . . . . . 51
  Individual Study Carrel—Space Requirements . . . . . 52
  Comparison of Study Station Types . . . . . 53

| | |
|---|---|
| Student Seating | 54 |
| Small-Group Study Rooms | 55 |
| Large-Group Study Rooms | 56 |
| Typing Room | 57 |
| Typewriter Carrels—Space Requirements | 58 |
| Microfilm Reading Room | 59 |
| Circulation Area | 60 |
| Law Librarian's Office | 61 |
| Secretarial Office—Librarian | 62 |
| Library Administrative Office | 63 |
| Library Administrative Office | 64 |
| Reference Librarian's Office | 65 |
| Technical Service Work Area | 66-67 |
| Library Shipping and Receiving Room | 68 |
| Computer Terminal Room | 69 |
| Food Serving Room | 70 |
| Copy Center | 71 |
| Vending Machine and Lunch Room | 72 |
| Custodial Office | 73 |
| Audiovisual Equipment Room | 74 |
| Master Control Room | 75 |
| Storage and Preparation Room | 76 |

The Space Requirements information for the same building was as follows (each major room was assigned a facility number, and the number of square feet desired for each room was shown; the page numbers refer to the pages in the Program where detailed requirements for each room are to be found):

Space Requirements

| Offices and Related Rooms | Facility Number | See Page | Total Sq. Ft. |
|---|---|---|---|
| 1 Dean's Office | 1 | 17 | 254 |
| 2 Administrative Offices @ 185 sq. ft. each | 2 | 18 | 370 |
| 1 Secretarial Office—Dean | 3 | 19 | 150 |
| 1 Public Service and Reception Area | 4 | 20 | 650 |
| 1 Secretarial Work Room | 5 | 21 | 160 |
| 1 Conference and Council Room | 6 | 22 | 450 |
| 25 Faculty Offices @ 185 sq. ft. each | 7 | 23-24 | 4,625 |
| 2 Teaching Assistant Offices @ 185 sq. ft. each | 8 | 25 | 370 |
| 4 Typist Rooms—Faculty @ 150 sq. ft. each | 9 | 26 | 600 |
| 11 Student Organization Office Stations @ 100 sq. ft. each | 10 | 27 | 1,100 |
| 2 Student Organization Work Areas @ 558 sq. ft. each | 11 | 28 | 1,116 |
| 1 Spare Office | 12 | 29 | 185 |
| | | | 10,030 |

### Lecture and Related Rooms

| | | | |
|---|---|---|---|
| 1 Lecture Room, 250 students @ 11 sq. ft. each | 13 | 31-33 | 2,750 |
| 1 Moot Court and Lecture Room, 175 students @ 18 sq. ft. each (500 sq. ft. for Judges' Bench) | 14 | 34-35 | 3,650 |
| 1 Lecture Room, 125 students @ 18 sq. ft. each | 15 | 36-37 | 2,250 |
| 1 Lecture Room, 80 students @ 18 sq. ft. each | 16 | 38-39 | 1,440 |
| 1 Lecture Room, 50 students @ 20 sq. ft. each | 17 | 40-41 | 1,000 |
| 1 Lecture Room, 37 students @ 20 sq. ft. each | 18 | 42-43 | 740 |
| 3 Lecture Rooms, 40 seats each @ 14 sq. ft. each | 19 | 44-45 | 1,680 |
| 3 Seminar Rooms, 25 seats each @ 20 sq. ft. each seat (100 additional sq. ft. for Storage) | 20 | 46 | 1,800 |
| 1 Student Common Room | 21 | 47 | 750 |
| | | | 16,060 |

### Law Library

| | | | |
|---|---|---|---|
| Book Collection (200,000 vols. @ 10 vols. per sq. ft.) | 22 | 48 | 20,000 |
| Reserve Book and Controlled Study Area | 23 | 49 | 900 |
| Student Seating, 420 Carrel and 36 Table Study Stations @ 28.25 sq. ft. each | 24 | 54 | 12,880 |
| 8 Small-Group Study Rooms, @ 100 sq. ft. each | 25 | 55 | 800 |
| 2 Large-Group Study Rooms, @ 240 sq. ft. each | 26 | 56 | 480 |
| 2 Typing Rooms, @ 200 sq. ft. each | 27 | 57 | 400 |
| 1 Microfilm Reading Room | 28 | 59 | 200 |
| Circulation Area | 29 | 60 | 500 |
| 1 Law Librarian's Office | 30 | 61 | 185 |
| 1 Secretarial Office—Librarian | 31 | 62 | 125 |
| 1 Library Administrative Office | 32 | 63 | 125 |
| 1 Library Administrative Office | 33 | 64 | 100 |
| 1 Reference Librarian's Office | 34 | 65 | 150 |
| Technical Service Work Area | 35 | 66-67 | 2,010 |
| 1 Library Shipping and Receiving Room | 36 | 68 | 375 |
| 1 Computer Terminal Room | 37 | 69 | 200 |
| | | | 39,430 |

### Other Rooms

| | | | |
|---|---|---|---|
| 1 Food Serving Room | 38 | 70 | 100 |
| Copy Center | 39 | 71 | 340 |

| | | | |
|---|---|---|---|
| Vending Machine and Lunch Room | 40 | 72 | 600 |
| 1 Custodial Office | 41 | 73 | 100 |
| 1 Audiovisual Equipment Room | 42 | 74 | 360 |
| 1 Master Control Room | 43 | 75 | 100 |
| 1 Storage and Preparation Room | 44 | 76 | 100 |
| | | | 1,700 |

| | |
|---|---|
| Net Assignable Sq. Ft. (69% of Gross) | 67,230 |
| Net Unassignable Sq. Ft. (31% of Gross) | 30,205 |
| Total Gross Floor Area | 97,435 |

From the above material, facility number 14, pages 34 and 35, was selected to illustrate the amount of thought given to each facility required. Obviously the preparation of this much detail for every room in a major building requires much thought and work on the part of many, but the final results are worth it. The better a building fits the users' needs in the beginning, the less remodeling there will be to do. And that is a most important factor.

## Facility 14
## Moot Court and Lecture Room

| | |
|---|---|
| Number Required | 1 |
| Total Seats | 175 @ 18 sq. ft. each |
| Type of Seating | Continuous, fixed tables with movable chairs |
| Floor Area | 3,650 sq. ft. (including 500 sq. ft. for judges' bench, functional jury space, and access to front of classroom for judge or instructor) |
| Floor Material | Carpet or carpet runners |
| Floor Type | Terraced or sloping |
| Wall Material | Wood panel |
| Ceiling Material | Hard and sound reflective |
| Ceiling Height | 8 ft. minimum at rear of room |
| Recommended Location | Location in building on second floor level near Student Common, Facility 21. |
| Justification | See page 30 |

Furniture and Equipment to be furnished by contractor

- Court room and instructor's bench and jury facilities
- Chalkboard with map track at front of room
- 4 lineal ft. of corkboard on side wall near an exit door
- Clock on side wall
- Provisions for mounting one 12' projection screen at front of room (Screen shall be mounted at proper angle for projection from rear of room.)

Furniture and Equipment to be furnished by owner

- 175 seats for continuous tables (these may be attached to table supports)
- Fixed tables for 175 students

1 movable lectern, table model
1 instructor's stool
1 wastebasket
1 movable demonstration/lecture table (36" high x 27" x 72")
Projection cabinet

Special Requirements

Rear entrance very desirable
Stairway within room if necessary
Windows not required

Special care shall be exercised in planning this room so that it will function well as a classroom, and so that it can be made to appear proper and function well as a Moot Court Room.

Lighting

All light fixtures shall be fluorescent type, flush or surface mounted in rows parallel to the front wall of the room. Alternate fixtures on the back row shall be switched separately from all others to provide a low light level for note-taking during movie, slide, or television presentation. Switches for all lights should be located both in the front and in the rear center of the room and at the entrance if it is not near one of these two switch locations. If surface-mounted fixtures are used, the note-taking lights must have a shield hanging in front of them to shade the projection screen.

Audio

Recessed box (8" x 10" x 6") with 120-volt power located in front wall of room (for audio amp. and audio junction).

Switchbox with blank cover, 18" from floor at center of rear wall (for projector)

Switchbox with blank cover, at high level on each side of room (for speakers)

A ¾" conduit shall connect each of these boxes with the 8" x 10" x 6" box, and this junction box shall be connected to the Master Control Room, Facility 43, with two ¾" conduits.

Television

Switchboxes in ceiling for television monitors. Provide 120-volt power near each monitor.

Switchbox in front wall of room (for television remote jack and television cable junction).

A ¾" conduit shall connect all ceiling-mounted monitor switchboxes with the junction box in the front wall of room. A ¾" conduit shall connect the TV junction box with the Master Control Room, Facility 43.

Utilities Required

Electrical: 120-volt, single-phase, duplex receptacles located on walls including one at front center of room and several in or near the projection cabinet.

Preparing a program in this much detail will require a considerable amount of time. In fact, some may feel that with building costs continually rising, so

Careful attention should be given, during the programming and planning stages, to appearance, ease of making future alterations and changes, and factors contributing to lower maintenance and operating costs.

much time cannot be taken. However, those who are in a hurry should remember this: the cost of a good building is soon forgotten, but the cost of a poor one is never forgotten. The answer, so far as programming is concerned, is to free those who are to do most of the work on the Program from other duties insofar as possible, and produce the Program within a reasonable length of time. If speed is the major concern, it might be necessary to omit the programming phase altogether and let the architect do his best to produce a functional building in the time allowed. But the first cost of any building is less than the cost of maintaining, remodeling, and operating it over the life span of the building. Therefore, a well-planned and well-constructed building of good and easily maintained materials might cost more initially but be the better buy by far over the years. Good programming is certainly an important part of good planning.

A checklist is helpful to the committee charged with the responsibility of preparing a Program of Requirements for a building. A reminder to the committee members of the available finishes, materials, and features, helps them choose quickly whatever will be best for given situations. The following excerpt from a checklist developed at Brigham Young University exemplifies the type of information useful to the ad hoc planning (building) committee as they prepare their Program of Requirements:

A. Floor Material
   1. Vinyl asbestos tile
   2. Carpet
   3. Concrete, sealed
   4. Ceramic tile
   5. Quarry tile
   6. Hardwood
   7. Sheet vinyl
   8.

B. Wall Material
   1. Painted lava block
   2. Wood panel
   3. Plaster or sheetrock, painted
   4. Glazed structural tile
   5. Concrete or masonry, unfinished
   6. Ceramic tile
   7. Sound absorbent
   8. Movable
   9 Nonflaking, washable material
   10.

C. Ceiling Material
   1. Acoustic tile or other sound-absorbent material
   2. Plaster or sheetrock, painted; or other sound-reflective surface
   3. Exposed structural system, painted
   4. Exposed structural system, unfinished
   5. Wood
   6. Sound-absorbent, nonflaking, and washable material
   7.

D. Special Requirements
   1. Air conditioned
   2. Temperature, ___ degrees Farenheit, plus or minus ___ degrees.
   3. Humidity, ___ percent, plus or minus ___ percent.
   4. Air filtering, ___ percent.
   5. No windows
   6. Exterior windows desirable
   7. Exterior windows required
   8. Interior windows required
   9. 120-volt, single-phase electrical outlets
   10. 208-volt, single-phase electrical outlets

11. 208-volt, 3-phase electrical outlets
12. ___ footcandles at table height, fluorescent fixtures
13. ___ footcandles at table height, incandescent fixtures
14. Lighting for projection and TV
15. ___ telephones, located on desk/s
16. ___ telephones, located on wall
17. Conduits for audio
18. Conduits for television
19. Conduits for intercom
20. Conduits for computer terminal
21. Sink with hot and cold water and drain
22. ___ lineal feet of cabinet along one wall, with sink, hot and cold water and drain
23. Floor drain
24. Compressed air
25. Vacuum
26. Natural gas
27. Coat rack, wall type with ___ hooks
28. ___ feet of adjustable bookshelving, without doors, bracketed to wall
29. ___ feet of adjustable bookshelving, with doors, bracketed to wall
30. ___ lineal feet of chalkboard with map track
31. ___ lineal feet of corkboard
32. Picture molding on walls where practical
33. Clock on side wall
34. Projection screen cove with electricity
35. Projection screen cove without electricity
36.

E. Furniture and Equipment to Be Furnished by Owner

1. ___ desk/s, secretarial
2. ___ desk/s, executive, 36" x 72"
3. ___ desk/s, faculty, 30" x 60"
4. ___ credenza/s
5. ___ table/s, 20" x 60"
6. ___ table/s, 30" x 60"
7. ___ table/s, 36" x 72"
8. ___ table/s, 36" x 96"
9. ___ table/s, conference
10. ___ swivel chair/s, executive
11. ___ swivel chair/s, faculty
12. ___ swivel chair/s, secretarial
13. ___ armchair/s
14. ___ straight-back chair/s
15. ___ chair/s, table arm, movable
16. ___ chair/s, table arm, fixed
17. ___ chair/s, auditorium table arm, upholstered
18. ___ chair/s, auditorium table arm
19. ___ wastebasket/s
20. ___ standard filing cabinet/s, four drawer, letter size
21. ___ standard filing cabinet/s, four drawer, legal size
22. ___ lateral filing cabinet/s, four drawer, letter size
23. ___ lateral filing cabinet/s, four drawer, legal size
24. ___ supply storage cabinet/s

25. ___ bookcase/s, 12 lineal feet of shelves
26. ___ utility rack/s (bookcase/s), 24 lineal feet of shelves
27. ___ lectern, table model
28. ___ movable demonstration table (36" high x 27 x 72")
29. ___ roll table/s with shelves
30. ___ pencil sharpeners
31. ___ projection stand, movable
32. ___ projection screen
33. ___ faculty name and schedule holder/s on corridor side of wall
34. ___ sound-absorbent office station divider/s

## Selecting Architects and Engineers

Several systems are used by colleges and universities to secure their building plans. Some states have central planning offices that do all or most of the architectural work for their schools. A few schools might have their own architectural offices and do some of their own planning. Some schools will use only one professional firm of private architects, and that firm will do all of the school's work. Some schools use several firms of architects and thus pass the work around. Other schools use combinations of the above systems.

But whatever the system, no school should employ an architectural firm without first checking carefully its professional qualifications and desire to cooperate fully with the school. The size of a firm does not always indicate architectural excellence. Many splendid architects prefer to keep their offices small in order to be able to give their personal attention to their work.

Most architects prepare brochures listing the professional training and experience of the principal members of their firms, and the kind and size of the major projects they have accomplished. These brochures should be kept in the files of the central planning office.

A common way (and a good way) to select an architectural firm is for the Campus Planning Committee to screen the files, interview potential architects, and recommend a firm to the president, who will in turn get approval from the Board of Trustees or Regents. Sometimes architects are selected by a State Building Board or from a list of architects submitted to the State Building Board. Occasionally politics have as much to do with the selection of the architect as does his architectural ability. Even if good architects are chosen this way, it is too bad that the selection could not be made solely on the basis of professional excellence. It is highly desirable to have the architects being considered for a project appear before the Campus Planning Committee to show slides of their work and to answer questions. Often members of the ad hoc building committee will feel that they should select the architect. There is no objection to their being part of the screening process, but university buildings are the property of the state or of a governing body, and the first users of a building are just the beginning of a long line of users that will occupy the building during its life span. As a consequence, the selection of an architect and the approval of his engineers should be made by those most experienced in such matters.

According to Harold C. Babcock, director of Physical Plant at the University of Oregon,

> *Architects are selected by a faculty and staff subcommittee appointed by the chairperson of the Campus Planning Committee who makes recommendation to the president of the university. This subcommittee consists of the University architect (Physical Plant), university planner (Physical Plant), the Dean of the School of Architecture and Allied Arts, and a faculty member at large. This group conducts preliminary screenings of eligible consultants or firms, interviews those chosen and transmits to the president's office the three most desired and qualified firms. After presidential concurrence, these firms are forwarded to the Chancellor's office for selection of one and negotiation of agreement between the successful firm and the State System of Higher Education.*[8]

Booker Conley, director of Physical Plant, Tuskegee Institute, writes, "Architects are selected by the president after recommendation from our architectural consultant, Vice President for Business Affairs, Physical Plant Director, and the principal head who will use the building."[9]

Wayne McMurtry, director of Administrative Services, University of Southern Colorado, states,

> *Architects and engineers are selected through resumes of professional organizations kept on file in the office, and from them a list of potential architects is prepared for each project. A committee of representatives throughout the institution, particularly those directly involved with the new facility, interviews architects; and concurrent with a recommendation from this office to the college president, a recommendation is made. The ultimate naming of an architect by statute is the responsibility of the Governing Board. I have never known a firm being named other than the one recommended by the president. There is much interaction between this office and the president's office on this particular item.*[10]

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[8] Harold C. Babcock, Director of Physical Plant, University of Oregon, Response to Author's Questionnaire on Planning and Construction, 1975.

[9] Booker Conley, Director of Physical Plant, Tuskegee Institute, Response to Author's Questionnaire on Planning and Construction, 1975.

[10] Wayne McMurtry, Director of Administrative Services, University of Southern Colorado, Response to Author's Questionnaire on Planning and Construction, 1975.

From the University of Maine, Richard A. Eustis, director of Physical Facilities, reports,

> *Architects or engineers for major projects are selected by the following method: From our knowledge of the capabilities of various firms, combined with our knowledge of the project requirements, the Office of Physical Facilities recommends firms to the president of the campus on which the project will be built, and together a recommendation is arrived at which is forwarded through the Chancellor to the Board of Trustees for their approval.*[11]

A. Ross Dawson, director of Campus Planning at York University, Ontario, Canada, reports on how architects and engineers are selected: "A short list of consultants, prepared by the Director of Campus Planning is submitted to the Physical Resources Committee (a presidential committee on campus development) and a specific recommendation is made to the university's Board of Governors."[12]

Rino Bianchi, director of Facilities Planning for Southern Illinois University, reports,

> *For small projects, local professionals are used generally, chosen by the Facilities Planning Office, with the work more or less divided among them evenly. For larger projects, three or four are chosen by Facilities Planning. These are interviewed by a selection committee (Vice President for Development and Services, Director of Facilities Planning, Campus Architect, and a representative of the using department) and referred to the Board of Trustees who approve and forward to the Capital Development Board (a state wide board for planning, funding, and construction of all capital construction in the state.) If they approve the choice, they enter into a contract with the architect or engineer.*[13]

In selecting architects for major projects, the school might consider having two or more firms work together. This has proven to be most advantageous in a number of instances. The major advantages are that more than one principal is involved, with correspondingly broader and more diversified experience, and that more draftsmen, specification writers, and office help are available for faster production of contract documents. It is especially desirable to have an association of firms if one of them is from out of state or distantly removed from campus. A local or nearby firm, familiar as it is with local codes and requirements, would be invaluable to the distant firm. The local firm could maintain frequent (daily if necessary) contact with the school and could secure the necessary information and input from the faculty and staff to pass on to their professional associates. The local firm would also be the logical one to furnish architectural supervision during construction. They would be available when architectural assistance is needed on very short notice. Experience has shown that an association of firms need not increase the fee. The architects and their engineers will get together and assign responsibility and agree among themselves on how the fee will be divided.

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[11] Richard A. Eustis, Director of Physical Facilities, University of Maine, Response to Author's Questionnaire on Planning and Construction, 1975.

[12] A. Ross Dawson, Director of Campus Planning, York University, Ontario, Canada, Response to Author's Questionnaire on Planning and Construction, 1975.

[13] Rino Bianchi, Director of Facilities Planning, Southern Illinois University, Response to Author's Questionnaire on Planning and Construction, 1975.

After the architect is selected, and before a contract is signed, a few other things should be discussed and agreed upon. There is the matter of his fee. In many states, fees for all state work are established on a sliding scale. In those states there is little to discuss. However, there are variations as indicated by the following: "Architectural fees are based on a schedule of minimum professional charges issued by the Ontario Association of Architects. Generally, they are on a percentage basis varying inversely to the size of the project and directly to its complexity. Similarly, the engineering fees are related to a scale of fees published by the Association of Professional Engineers of the Province of Ontario."[14]

"Architectural fees are based on a percentage of total project costs (6%). There is 4 percent for design, 2 percent for construction management as set forth by Arizona Revised Statutes." [15]

*When the university contracts with an architect or engineer directly for new work, the fee is 6 percent of final cost. On remodeling and renovation, we like a letter contract based on out-of-pocket expenses plus an hourly rate. Building Commission contracts on almost every type of work specify 6 percent on first $500,000, 5 percent on next $500,000, and 4 percent of all*

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[14] A. Ross Dawson, Director of Campus Planning, York University, Ontario, Canada, Response to Author's Questionnaire on Planning and Construction, 1975.

[15] Guy F. Ferro, Facilities Planner, University of Arizona, Response to Author's Questionnaire on Planning and Construction, 1975.

*over $1,000,000. Rarely they will up fees for complex additions and alterations and then it is upon a mutually agreed rate.*[16]

"We use the A.I.A. fee scale, negotiating with the architect or engineer as to the degree of difficulty and the probable range of cost. These two items provide a target fee area that is then negotiated in detail for the final percentage figure."[17]

"Fees negotiated by the State University Construction Fund (SUCF), generally conform to A.I.A. regional fee scale for basic services plus separately negotiated amount for special or additional services, if any."[18]

The Preliminary Program of Requirements should be thoroughly reviewed and the architect should say, "Yes, I can do the project as outlined for the amount of money indicated, and I will take it on the basis of your requirements and proposed budget." Or he should say, "I don't believe it is possible to meet your programmed requirements and do it within your proposed budget." If he accepts the project on the basis of the program and the proposed budget, he should do all within his power not to exceed the budget. On the other hand, the school should not increase its requirements without being willing to increase the budget. If the architect feels that the proposed budget is insufficient, the owner has five choices: (1) increase the amount of money budgeted for the project, (2) reduce the requirements to meet the budget, (3) combine an increased budget with reduced requirements, (4) talk to other architects and perhaps contractors to see if they agree that the proposed budget is unrealistic, (5) if others feel that the budget is sufficient and the number-one choice still says "no," the owner may decide to go with another architect. The owner should not expect the architect to do the impossible, and the architect should not mislead the owner by signing a contract when he is fully convinced that the project is underfinanced. Of course, the owner may decide to go ahead and take a chance that the architect is wrong, that the budget will be sufficient. This course of action is proper if everyone concerned is aware that the architect may be right and should not be blamed if—after he does all that can be expected to keep costs down—at the bid opening he is proven right.

While discussing the contract with the architect, it would be well to have him name his choice of structural, mechanical, electrical, acoustical, and other engineers. If any of those he recommends are not satisfactory to the owner, they should discuss the matter frankly and agree upon mutually acceptable ones. The architect should name himself, or some person in his office, as the owner's contact man, and the school should designate someone as its owner's representative. Occasionally the principal of a design firm will start a project and then, before it is very far along, assign a less-qualified member of the firm to take over. An understanding should be had before contracts are signed. Changing key personnel during the design stages can and will present problems. Also, when the project manager of an architectural firm leaves that firm in the middle of a project, the owner will have problems. Perhaps this type of situation is unavoidable, but an early investigation of the status of the project manager with the architectural firm is advisable. Finally, the type of fee needs to be decided upon—whether it will be a percentage of the final contract cost, a fixed fee, or lump sum.

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[16] John W. White, Director of Physical Plant, University of Mississippi, Response to Author's Questionnaire on Planning and Construction, 1975.

[17] Lawrence L. Ketchen, Director of Facilities Planning and Construction, Tufts University, Response to Author's Questionnaire on Planning and Construction, 1975.

[18] Frank A. Kopf, Director of Physical Plant, State University of New York at Albany, Response to Author's Questionnaire on Planning and Construction, 1975.

> *The practice of establishing a fee based on percentage of the cost of the work has come under considerable discussion recently within the architectural profession. This custom has been based on a minimum fee schedule prepared by the architects' local association with the individual architectural offices expected to adhere to this minimum schedule. Several federal agencies have refused to accept such a schedule in the negotiation of contracts. Recently, the Supreme Court has ruled a similar minimum fee schedule used by certain attorneys to be improper.*
>
> *The A.I.A. has, within the month, made available a new procedure for negotiating architectural fees identified as 'Compensation Management.' Under this new procedure, the work which the client desires an architect to do is listed in some detail. The architect is asked to have available office costs which are associated with the different phases of the firm's services; and in the negotiation, an amount is set to cover the individual detailed costs which the architect may expect. The summation of these costs to which are added amounts for overhead and professional fee, establish the contract amount for the architectural services. It appears that this may be the expected procedure in the future and institutional officers would do well to familiarize themselves with the procedure.*[19]

Another matter that should be settled with the architect before finalizing the contract is the type of supervision that the architect will render during construction. The agreement should then be made a part of his contract. His services might call for complete and regular supervision of construction including "Clerk of the Works." It might be limited supervision, whereby the owner, or the agency representing the owner, would provide the day-by-day building inspection and "Clerk of the Works" functions. Or the architect might have minimal responsibility for the construction itself. A school with no regular planning or construction personnel would probably do best to have the architect represent the school and do all the inspection, paper work, and other things required during the construction period. Schools that have their own planning and construction personnel, or that have such personnel provided by the state, would probably do best to request that the architect provide only limited supervision. He or his representative would sit in on job meetings, prepare change orders, and be available when needed on the job. He would make periodic inspections with the owner's representative to satisfy himself that things were going well. The owner would provide the day-by-day inspection work and would handle the paper work involved during construction. For this type of service, the architect should be paid a smaller fee than he would receive for providing a complete service, including supervision of construction.

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[19] Fred L. Markham, F.A.I.A., of Markham and Markham, Architects and Engineers, Provo, Utah, Written Statement to Author, 1975.

## Architectural and Engineering Contracts

There are a number of architectural contracts used throughout the country. Most schools and state agencies that do considerable building have more or less developed their own version of a standard architectural and engineering contract. Often they are patterned after standard forms developed by the American Institute of Architects (AIA). Some architectural agreements are several pages in length and cover about every contingency that could conceivably arise. Others are very short and constitute little more than a memorandum of understanding between the owner and the architect. (*See* the short but adequate "contract between owner and architect" in Appendix C.) On alteration projects and smaller construction projects, the architectural agreement might provide for paying the architect a certain hourly rate for personnel plus a percentage fee to cover office, taxes, profit, and other expenses. This type of agreement is simple to prepare and has proven adequate for many small projects. It would not, however, be adequate for a major project. See page 71 for a prototype of such an architectural agreement.

"It is advisable that the contract form stipulate in detail the various duties which are to be performed by the architect. The degree of detail may vary depending upon the phase of the project and the number of duties for which the architect will be responsible."[20]

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[20] Markham, Written Statement to Author, 1975.

There are certain attachments which experience has shown to be desirable for architectural contracts. The school that has its own landscape architect in the Department of Physical Plant or in the planning office might find something like the following to be an appropriate annex to its architectural contracts. (This and the several subsequent attachments are in use at Brigham Young University.)

> The following provisions shall be added to paragraph____ on page____ .
>
> The architect agrees to work with the landscape architect appointed by the university in the development of landscape plans in the immediate vicinity of the project. Any fees paid to the landscape architect will be the obligation of the university. However, the landscape plans are to be coordinated by the architect and made a part of the final plans and specifications as submitted by the architect if requested to do so by the university.

Because some architectural contracts extend over a rather long period, and because life is uncertain at best, it would perhaps be wise to include something like the following in at least major architectural contracts:

> Paragraph ____ on page ____ is amended to read as follows:
>
> If the architect is one person and he becomes incapacitated, he or his representative shall, or if he dies his representatives shall, promptly deliver to the owner all drawings and papers relating to his work and services hereunder, and the owner shall pay therefor such equitable portion of the remuneration herein provided as may be proper and fair. [A statement could be added that the school would have the option of continuing the project with a staff member of the firm if the school deemed the staff member competent to complete the terms of the contract in a satisfactory manner.] If the architect consists of two or more persons, in case of the death or disability of one or more of them, the owner shall have the option of either (a) terminating this agreement or (b) recognizing the other or others of said persons (hereinafter called the "survivor or survivors") as the successor to the architect. If the second of said options is elected, the said survivor or survivors shall be responsible for the completion of the services covered by this agreement in accordance with the provisions hereof.

It isn't too often that a difference between the architect and the owner demands arbitration, but there is no harm in providing for this just in case it is needed. A short provision like the following should be adequate:

> The following provision is added to paragraph ____ on page ____ :
>
> Notice of demand for arbitration shall be filed in writing with the other party within ten (10) days after the parties hereto have found it impossible to agree upon a settlement of the dispute, and the respective committee members shall be appointed by the parties within five (5) days after the giving of such notice.

The following clause should be added if appropriate:

> The architect agrees to work with any consultants employed by ____ College. Any fee paid the consultants will be the obligation of ____ College. However, the plans and specifications, as submitted by the consultants, are to be coordinated by the architect with the architectural plans and specifications.

Where an architect's fee is based upon a percentage of the mutually agreed upon construction cost, there is always the possibility of a disagreement if the construction cost runs considerably higher than the estimate. Let us suppose that the architect has agreed to a fee of 6 percent for a project which he has also agreed, before signing the contract, should not exceed five million dollars. Then the lowest bid turns out to be five and one half million. The architect may claim he is entitled to 6 percent of the low bid; the owner may feel differently. Both architect and owner might be partially right, but to try and forestall any such unpleasantness at the end of the project, something similar to the following might be acceptable to both the owner and the architect as an inclusion to the architectural contract:

> The following provision is added to paragraph ____ page ____:
>
> This contract being on a percentage basis, the architect's final fee will be calculated after the project is complete and the exact contract price is determined. The price will be determined by taking the original contract price minus all credits to the contract during construction, plus all extras to the contract during the construction, except that no architect's fee will be paid on any amount greater than 110 percent of the construction costs shown in paragraph ____ on page ____ of this agreement. Should the final contract price be less than the construction cost shown in paragraph ____ on page ____ of this agreement, the architect's fee will be as shown in paragraph ____ on page ____ of this agreement.

The following is an example of how the architectural payments might be calculated and paid to the architect from the beginning of design to the end of construction:

> The following provisions are added to paragraph ____ page ____:
>
> The payment of architect's fee shall be made as follows:
>
> *Schematic Stage.* Payment will be ten percent (10%) of the fee and shall total $14,765.00 payable in two (2) equal monthly installments of $7,382.50 each, with the understanding that if the Schematic drawings are completed and approved prior to the expiration of the said two (2) months, the architect shall thereupon be paid the difference between said $14,765.00 and the amount thereof actually received by him.
>
> *Preliminary Stage (Design-Development Stage).* Payment will be fifteen percent (15%) of the fee and shall total $22,150.00 payable in two (2) equal monthly installments of $11,075.00 each, with the understanding that if the preliminary drawings are completed and approved prior to the expiration date of the said two (2) months, the architect shall thereupon be paid the difference between said $22,150.00 and the amount thereof actually received by him.

*Working-Drawing Stage.* Payments will be forty percent (40%) of the fee and shall total $59,060.00 payable in six (6) monthly installments of $9,843.33 each, with the understanding that upon the completion and acceptance of the working drawings and specifications, the architect shall thereupon be paid the difference between said $59,060.00 and the amount thereon actually received by him.

*Construction Stage.* Payment will be thirty-five percent (35%) of the fee and shall total $51,677.00. This portion of the fee will be paid on a monthly inspection basis to be determined by the completion schedule of the contractor.

The following "cost plus" architect's agreement employed at Brigham Young University is about as simple a contract as can be drawn and yet it and similar ones have proven adequate on relatively small projects.

## Architect's Agreement
### (Cost Plus Percentage Fee)

1. This agreement, made and executed this ____ day of ______, 19__, by and between the _______ University, hereinafter called the "owner" and _______, hereinafter called the "architect,"

Witnesseth that in consideration of the mutual covenants herein contained to be well and faithfully performed, the parties hereto agree as follows:

2. **Employment of Architect**

The owner hereby employs the Architect to perform all pertinent professional services incident to furnishing detailed plans and specifications to construct a costume storage area over the Handball Courts in the Fieldhouse. This is to include the necessary structural work, lighting, fire protection, and ventilation. All the work imposed by this contract is to be done on the main campus of ______ University.

The authorized agent of the owner is _______. All information or direction desired or required by the architect shall be obtained from said agent.

3. **The Owner Agrees**

   a. To furnish to the architect an outline of requirements for this project and

   b. To give thorough consideration to all reports and recommendations submitted by the architect, and to inform the architect of its decisions within a reasonable time so as not to delay the work of the architect.

4. **The Architect Agrees**

   a. After receiving the owner's Program of Requirements, to visit the site with the owner's designated representative in order to familiarize himself with all governing site conditions.

b. To furnish all necessary architectural, engineering, and supervisory services as may be necessary to satisfactorily meet the requirements of the owner.

5. **Compensation of the Architect**

a. The owner agrees to pay the architect for the work and services contemplated under the terms of this agreement, the amount determined by using the approved hourly rates for the principal and his employees as shown in this Agreement, plus 60 percent for overhead.

b. Payments shall be made monthly after presentation and approval of invoices.

**Compensation Schedule**

| | | |
|---|---|---|
| 1. | Designer—Job Captain | $12.00 per hour |
| 2. | Designer—Grade 1<br>Supervisor Inspector | 10.00 per hour |
| 3. | Draftsmen—Class 1 | 7.00 per hour |
| 4. | Secretarial | 5.00 per hour |
| 5. | Plus 60 percent for office overhead | |
| 6. | The owner will reimburse the Architect for the cost of all contract documents. | |

6. In witness whereof, the owner has caused this contract to be signed by its proper officers, and the architect above named has hereunto set his hand, the day and year first above written.

Owner

______________________University

By __________________________
President

The Architect

______________________________

The relationship between the architect and the owner can be most pleasant if each will recognize and respect the rights and responsibilities of the other. The licensed professional architect has spent years learning his business. The business of architecture is a complicated and demanding one requiring great expertise, not only in design and in knowledge of building construction, but also in the more intangible areas of aesthetics and art. At the same time, if he is to survive in his competitive profession, the architect must be a businessman. The ability to sell his services and to relate well with his client is an important factor in the architect's successful practice of his profession. Any architect worthy of selection to do a major college or university building will have these attributes and more. Why, then, should the owner, with no training whatever in design and construction, undertake to second-guess the architect on these sensitive and important subjects when the architect's proven ability in these fields is the reason he was employed in the first place? For a college or university that has a planning office staffed with professional architects and engineers, the situation is different. Here are representatives of the owner who are also knowledgeable in architectural matters and who can help immeasurably by serving as a liaison between the architect and the future users of the building.

But how about the architect's clients, the future users of the building he is to design? It is quite possible that they are just as knowledgeable in their several fields of endeavor as the architect is in his. These future users are, or should be, in a far better position to know what their functional needs are than would the architect. It is a fact that the practical and functional arrangement of spaces and facilities in the building will determine to a large extent how well the users will be able to carry out their duties. Who, then, has a better right to be heard than the owner, who not only will pay the architect his fee, but will also pay the other costs connected with the construction and occupancy of the building?

When he is designing a university or college building, the architect does not have just one professional in one field of endeavor to deal with. He will have several. This can further complicate matters, because often these several specialized professionals who will jointly use certain spaces in the new building cannot agree among themselves as to what is needed. When this happens, the architect must exercise a large measure of tact, diplomacy, and patience. But this situation, which could become a major problem for the architect, can largely be prevented if the ad hoc planning committee for a particular building has done a good job of ironing out differences of opinions and related problems before the architect becomes involved.

A lawyer who would never think of taking his sick child to an architect for treatment, or the history professor who would never think of sending his ailing wife to a lawyer for a medical checkup, will seldom hesitate to tell the architect how to do the very things the architect was employed to do in the first place. The answer is that the architect has certain rights, and the owner has certain rights. Neither can do a good job without the other. A good job may not be forthcoming if the architect or the client refuses to give careful and sympathetic attention to the opinions and recommendations of the other. Many people are involved in the programming, planning, and construction of a major college building. The better all understand and recognize each other's strengths and limitations, and the better they cooperate with one another, the better the finished product will be.

The owner should recognize the architect as the person with the most know-how within the limits of his profession. Similarly, the architect should recognize that the owner and his representatives have great expertise in their fields of endeavor and, further, that the owner controls the money and can, if he desires, choose another architect.

If an owner wants sketches and feasibility studies, he should pay the architect for them. The professional architect has nothing to sell but his services, and he must charge for them if he is to stay in business.

The owner should not expect to get more than he is prepared to pay for. To keep adding square feet and upgrading building components, but at the same time expecting the architect to produce the building for the original estimate, is wishful thinking and unfair to the architect.

It is not uncommon for the client to put great pressure on the architect to produce contract documents in an unrealistically short time and then take a long time to review the plans, "hash" them over, have changes of mind, arrange financing, get approvals, and so on. If instead, the school could speed up its end of the work and give the architect more time, the result would be a better building. Although the architect might be able to produce the architectural design in record time, getting the structural plans and well-coordinated electrical and mechanical plans, and then doing a thorough job of coordinating them can be a slow process—but a process of such importance that it should not be rushed.

In preparing the architectural contract, the school and the architect should discuss frankly and honestly the time needed to prepare and deliver a carefully detailed and coordinated set of plans, including the time required to develop schematics, preliminaries, and final contract documents. The architect should not agree to deliver such plans if he knows that the time discussed is so short that he will not be able to do a thorough job. An impossible completion date is fair neither to the school nor to the architect. The architect should realize the urgency, and the school administration should recognize the tremendous amount of thought and work that will be required to produce the documents. If both school and architect will recognize each other's situation, there should be no real problem in arriving at a mutually satisfactory completion date.

The architect might be most knowledgeable on construction costs, but there are many variables; and the owner should not expect the architect to be infallible in his preliminary estimates. He will do the best that he can, but the difference between the low and high bids, submitted by general contractors with complete contract documents to work with, will often amount to hundreds of thousands of dollars on sizable projects.

Having a part in the programming, planning, and construction of a major university or college building is both a thrill and a challenge, and the secret to a happy and successful conclusion is cooperation by all concerned.

**Charrette**

This is a novel and interesting approach to planning, but it is doubtful that it has been used to any great extent in this country. It is included here because it is another method designed to produce a more functional building. The process involves bringing many people of diverse interests and talents together with the architect and other consultants. Carefully planned discussion groups are organized, and at designated times all groups meet together. Careful minutes of all meetings are kept. The final result, after two to ten days of concentrated effort, is a written record of the charrette that will enable the architect to produce a building well suited to the needs of those who will use it.

The charrette has been used successfully at Montana State University. Mr. A. A. (Andy) Van Teylingen, director of Facilities Planning at that university, supplied a detailed statement of what a charrette is, how it works, what is needed to make it work, and the results that it can produce. The following are extracts from Mr. Van Teylingen's explanation:

*A Charrette is a planning process that involves many people of diverse talents and relationships over a relatively short period of time. Its objective is to use the input from this group during this period to arrive at a viable solution to a problem. This requires intense effort with set deadlines. It means that during this period the participants will devote their entire time to the subject of the charrette—except when they are eating, sleeping, and occasionally relaxing.*

*In the late 1960's, the U.S. Office of Education came to the conclusion that a successful plan of a community's educational system and the execution of that plan would not only solve the educational problems but would also very likely solve other community problems. It was also its belief that such a planning process, to be successful, would need to involve the members of the community, experts from many fields, and take place in a relatively short time. Such a "high-voltage" session, because of its characteristics, became known as a charrette.*

*In order to be successful, a charrette, and those taking part in it, must have certain characteristics. Without these, a charrette will most likely not fulfill its goals and in some instances will do more harm than good. These characteristics are:*

*1.* Commitment. *Those sponsoring the charrette and those participating in it must be committed. The sponsors, those who have decision making author-*

*ity in the areas upon which the charrette will touch, must commit themselves to implement the solutions proposed insofar as it is possible; and they must effectively communicate this to the participants. The participants also must have commitment—commitment to devote their entire energy, time, and attention during the period to the charrette and commitment to the proposition that viable solutions to problems are possible to obtain within a finite time.*

2. Open-Mindedness. *Participants must not begin with preconceived solutions and fixed attitudes. If these are present and not overcome, effectiveness is greatly reduced; and the value of the outcome of the charrette is questionable. Administrators and/or policy makers must also have open minds about the outcome and must communicate this effectively to the participants.*

3. Diverse and Adequate Expertise and Talents. *This must be true of both the participants and the consultants, and there must be represented a broad range of backgrounds, philosophies, experiences, and outlooks. That consultants be experts in their field is mandatory, because their store of experience and knowledge is invaluable.*

4. Availability of Adequate Data. *There must be presented to all concerned sufficient information relative to the problem being considered to make them conversant with all facets. This must be done in a short length of time and in such a way that grasping it does not become a research project. This, of course, requires careful, thoughtful, and complete work on the part of those making preparations for the charrette. This cannot be over-emphasized. Sources of information also must be available during the charrette for expanding on that which has been presented.*

5. Follow Through. *This is related to commitment. If it is known at the beginning that follow through will exist, material generated is much more meaningful. To assure this at Montana State University, following two building project charrettes, members of the charrettes were selected by the participants to act as representatives on the building committee that prepared the detailed program.*

*Two salient characteristics of a charrette are:*

*1. During some periods, small teams (up to a membership of ten) work together; at other periods, the entire group works together.*

*2. The charrette works on a time table. This means that small-group discussions and large-group discussions will alternate and the agenda will set times for these discussion sections with finite proposed accomplishments.*

*Diverse special-interest groups should be members (students, staff, taxpayers—if a publicly supported school—members of the governing board,* *legislators—again if a publicly supported school—local townspeople, citizens of the state, etc.). Those who are what may be termed administrators of the school should, in the writer's opinion, be avoided. Adequate rapport between them and students and faculty may be difficult if not impossible to establish.*

*The consultants should have sufficient expertise in their fields to make knowledgeable contributions, and there should be enough of them to cover those areas of the charrette's interest.*

*The total number of participants should not be fewer than three discussion groups or teams of five each. More than four groups of more than ten each becomes somewhat unwieldy. (It is to be expected that interested persons of much diversity will become aware of the charrette, drop in at intervals, and at times become permanent members. They should be welcomed.)*

*While a charrette, if properly planned and conducted, is an effective planning process, the ultimate success of any planning is measured by what it produces. For this reason, let us look at the last phase—follow through.*

*The directions given by a charrette must be implemented if humanly possible. The commitment made must be executed. In the case of a building, its detailed program (if one is prepared), the drawings, and the ultimate structure must be done in accordance with the directions given by the charrette whenever possible.*

*A method of accomplishing this is to ask a few participants to follow through on the design of the building with the designer, doing such things as helping him choose color schemes. This is both possible and practical. The result can be illustrated by what a knowledgeable man said after having walked through a building that was planned in this manner: 'This is one of the most people-oriented buildings I've seen in a long time.' In addition, its occupants find that it has fewer flaws than most.*

*Having experienced this personally, the writer is convinced that the charrette is an invaluable planning tool.*[21]

## Field Trips

Some of the best money that can be spent during the planning of a major building is that used to finance properly conducted field trips. And yet, when forty-two schools were asked if they supplied their architects with field reports, ten said yes, twenty-three said no, six said sometimes, and three did not reply.

The first step necessary in organizing a field trip is to decide where to go.

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[21] A. A. Van Teylingen, Director of Facilities Planning, Montana State University, Written Statement to Author, 1975.

As a general rule, the schools to be visited should have buildings whose function is similar to that of the one being programmed. It is also desirable that the buildings be of late construction, not more than five years old. It isn't hard to locate schools with such buildings. Faculty and staff members keep posted on what their colleagues at other schools are doing. News of a recent and splendid building on another school campus soon circulates. The news may be spread by professional publications or by word of mouth. A letter or a telephone call will verify that a certain building on a certain campus is worthy of a visit. But as it often happens, one such building will be in eastern Canada and another will be in southern California. When schools are so widely scattered, the expense involved in visiting them can be quite heavy. The trick is to find a few schools with suitable buildings that can be visited with a minimum of travel.

Like most things, field trips need to be well organized and properly carried out if full value is to be realized from them. Too often such trips are made by the wrong people and do not produce the desired results because they turn out to be largely sight-seeing excursions. It is unrealistic to fly in and out of two or three cities, visit two or three schools for one to two hours each, all in one day, and expect to gain much information! Often such trips are made without taking notes or pictures. When such a party arrives home, the travelers are hard pressed to remember where they have been, much less what they have seen.

Another costly practice of doubtful value is to have faculty members take a trip "to find out what we need in our new building" months, and sometimes years, in advance of planning. Such a trip should be approved only if there is a compelling reason; most often, the time for a field trip is after the program is well along and after the architect has been selected. An ad hoc committee that has been at work for some time attempting to put down on paper their needs, and the needs of their associates, will be much more aware of what to look for at other schools than they would have been before starting the programming processes. Also, the architect will know better what to look for and what questions to ask after he has had a chance to review the preliminary Program of Requirements with the committee.

It is important to make the right decision as to who will make a trip. Five persons make a workable team. Certainly the architect should be one to go. If the school has a programmer who has been helping the ad hoc planning committee, he should go. There should be a knowledgeable member from the Physical Plant Department in the group. A member of the ad hoc planning committee, possibly the chairman, should be on the team. The fifth member might be a staff member from the planning office, the vice-president for Business, or the vice-president for Academic Affairs. When the building is to contain much mechanical equipment, as in a life-science building or a medical building, it would be highly desirable to include the mechanical engineer who will work with the architect. Sometimes the president will choose to go along. The composition of the visiting party can vary, but care should be exercised to include those persons who can get the most from the trip and can use the information obtained to help produce a better building.

Proper persons at the schools to be visited should be notified well in advance of the visitations. Quite often someone on the visiting team will know someone in the department or college to be visited and can make the necessary arrangements. If no one is known, key people who might be contacted would be: the dean of the college, a department chairman, or the director of Physical Plant. Experience has shown that school personnel enjoy showing their facilities and answering questions if they know that the visiting team has scheduled enough time to really see and understand what they are shown. Most take a rather dim view of the "pop-in" and quickly "pop-out" type of visit. Quite often a team will visit only the building's architect and its dean or department chairmen. These individuals can, and will, tell you all the good things about the building; they might even mention some of its shortcomings. They deserve an attentive ear. However, Physical Plant personnel should definitely be contacted. If there are mechanical, electrical, or structural problems, they will let you know. If there is a building engineer, be sure to contact him; if not, it will pay to talk with the head building custodian. A university or college building is a complex structure, and no one person has all the answers.

Before the team leaves on the trip, a written checklist should be carefully prepared listing all the items of principal concern and interest. The same information should be obtained at each facility visited. It is only by asking the same questions at several places and later comparing the answers that you really begin to form a true picture of what is good and what is not wanted.

The old adage about a picture being worth more than words is certainly true of field trips. It is advisable to carry two cameras—one with slow film for outside work, and one with fast film for inside work. Tripods and flash guns are too slow. Fast film by itself will provide sufficient detail.

Upon returning home, the programmer, the planning department representative, or a member of the ad hoc committee who participated in the trip should prepare the "trip report." The report will contain carefully documented answers to each of the questions and a copy of each photograph with an appropriate caption. The material should be assembled carefully and placed in large ring-binder notebooks. At least two copies should be prepared—one for the architect, and one for the ad hoc committee. It is desirable to have a third copy for the use of the programmer or the planning department personnel.

A team might visit from five to a dozen schools. The time required, if proper consideration is given to each visit, could run from five days to two weeks. The cost could run from a thousand dollars to four or five thousand. The information gained from such trips will enable the architect and his associates to do many fine things that they might not otherwise be aware of; perhaps even more important, many costly mistakes made by others can be avoided. A slogan for the visiting team might very well be, "If we make mistakes, let's make our own; let's not duplicate the mistakes of others."

When a project involves an investment of a million dollars or more, the benefits gained from a field trip could easily pay the cost of that field trip several times over. An expensive building that will probably be in use for fifty years or more deserves to be planned and constructed with all possible care. It has been shown that time and money spent on properly conducted field trips will help produce better buildings.

The following checklist, prepared for a field trip to study life-science buildings, will illustrate the type of information this particular team was interested in. They attempted to get as much information as they could on these subjects from each of the seven schools they visited. Their "trip report" consisted of 150 pages and contained text and photographs of great value to all who had any part in the planning of the building.

### Brigham Young University
### Life-Science Building Trip Checklist

- Date

- Name of Institution

- City and State

- Student Body
  - Undergraduate
  - Graduate

- Names
  - Dean
  - Department Chairman

- Departments
  - Number of Faculty
  - Number of Undergraduates
  - Number of Graduates
  - Number of Graduates Assisting in Teaching
  - Number of Graduates Assisting in Research
  - Floor Area Devoted to Research
  - Floor Area of Departments
    - Bacteriology
    - Botany
    - Zoology
    - Agricultural Economics
    - Agronomy
    - Animal Husbandry
    - Horticulture

- Building Studied
  - Name
  - Plans or Sketches
  - Architect and Address
  - General Shape
  - Gross Floor Area
  - Net Floor Area
  - Construction Cost
  - Project Cost
  - Year Completed
  - Number of Floors
  - Provision for Future Expansion

- Air Conditioning
  - Total or Partial
  - Type—Mechanical or Absorption
  - Engineer
  - Location of Equipment
  - Odor Control

- Windows
  - Rooms without Windows
    - Offices
    - Labs

- Sun Protection
  - Distance above Floor
- Walls
  - Exterior Material
  - Interior Material
- Floors
  - Structural Material
  - Covering
- Ceilings
  - Height
  - Material
- Corridors
  - Widths
  - Ceiling Heights
  - Lighting
  - Materials
- Classrooms
  - Type
  - Lighting
  - Number of Seats
  - Type of Seats
  - Size of Rooms
- Offices
  - Size and Proportion
  - Relationship to Lab
  - Lighting
- Graduate Student
  - Cubicles
  - Size of Ordinary
  - Size of Teaching
  - Number of Each per Department
  - Lighting
- Elevators
  - Number
  - Type
  - Make
  - Size of Cabs
- Stairs
  - Tread Material
- Fire Protection
  - Alarm System, supervised or not
  - Equipment in Building
- Small-Animal Facilities
  - Separate Building
  - Within Department
  - Odors
  - Ventilation System
- Disposal of Dead Animals
  - Disposals
  - Incinerators
  - Other
- Television Teaching Facilities
- Room-Darkening Facilities
- Cold-Temperature Rooms
- Photo Darkrooms
- Chemical Storage and Dispensing
- Food Technology
- Greenhouses
- Radiation Labs
- Plant-Growth Chambers
- Interdepartmental Equipment
- Museums
- Display Areas
- Soil Sterilization
- Meat Labs
- Wool Labs
- Nutrition Labs

### Determination of Office Space

When writing the Program of Requirements for a building, almost the first big policy decision to be made concerns office space. The questions are (1) Do we provide private single offices for everyone? (2) Do we have single offices for deans and department chairmen and double offices for everyone else? (3) Do we have offices largely on one floor or scattered throughout the building? (4) Do we eliminate private offices completely and have everyone share open spaces? (5) Do we have a few private offices and have the majority of the occupants share open spaces? (6) How much space will be allowed for each occupant? Answers to these questions are essential information for the architect, and the way they are answered can have a great deal to do with the cost of the building—cost not only for the original structure but also over its life span.

**Conventional Office Space.** The cost of a building goes up very rapidly when it is divided into many small spaces. Individual offices with their own lights, heating and cooling elements, thermostats, walls, and individual privacy behind closed doors are expensive luxuries that may not always be justified. Many private firms have discovered that private offices are not necessary. Many of these firms have arranged their spaces and treated the decor elegantly. And yet these firms have limited private offices largely for economical reasons. They have discovered that this is a way to save money without sacrificing efficiency or appearance. But a college or university staff member will likely insist that he must have a private office for one reason or another. The truth of the matter is probably that this insistence on a private office is based, not on actual need, but on customs of the past and on the individual's desire to enhance his prestige. Of course, some positions on a college or university campus require private offices, but many other positions and functions could operate just as efficiently, and perhaps more so, in large, landscaped, open spaces.

**Open-Space Planning (Office-Landscape Concept).** Ever-increasing construction costs and ever-increasing costs of alterations to accommodate new programs or new personnel have forced everyone to look for more economical and efficient ways of planning, constructing, and using buildings. One method, used successfully for years in some European countries, is catching on fast in this country. It is generally called "open-space planning" or "office landscaping."

"Developed and first used in Germany in 1960 by the Quickborner Team, Inc., this new office landscape concept departs from fixed walls and corridors used in conventional construction. In the past, because of the conventional construction, alterations to provide for additional personnel or organizational change within office areas have been costly and time consuming. The office landscape concept eliminates such drawbacks."[22]

The cost of remodeling and changing spaces is enough in itself to justify the use of a few large spaces instead of many small places. Even movable partitions are not that easy to put up and take down; and when any type of partition can be eliminated, a saving in money and an increase in efficiency is possible.

It is much easier, and therefore more economical, to rearrange furniture, screens, and tubs of plants to create new working and office space in a large landscaped area than it is to knock down partitions and rearrange the lighting, heating, and cooling to accomplish substantially the same results.

Experience has shown that proper use of carpeting, acoustical materials, simple free-standing screens, and a careful choice of plant materials affords good acoustical quality and satisfactory privacy. Screens, furniture, and plant materials can be quickly moved to provide new work spaces of whatever size and shape needed. The ability to make these changes economically is an important advantage because space requirements do change constantly. It is interesting to note, too, that the larger the space to be landscaped, the better the results will be.

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[22] "Administrative Services Building," *Information Booklet and Visitors Guide*, Purdue University, n.d.

Office landscaping seems to be catching on fast. It is not known how many schools are using it in one form or another. Possibly its biggest use at present is in remodeling or alteration projects—projects demanding new functional arrangement of spaces. In place of rebuilding partitions and involving all the related expense, open-space office arrangement is used. This is a good way for a school to try the system. Experience and a measure of acceptance could be gained before using it totally in a large new building.

Purdue University did the pioneer work in this country when they researched, designed, and constructed their splendid administrative services building. Bid in January 1969 and occupied in October 1971, it was the first structure of its kind in the United States. It contains 104,261 square feet and was constructed at a cost of $24.15 per square foot construction cost and $31.60 per square foot project cost. In a letter to the author, dated February 17, 1976, Walter W. Wade, director of Physical Plant at Purdue, compared the cost of the administrative services building with a comparable building constructed in the conventional manner. His conclusion was,

> *Had we designed the Administrative Services Building with conventional cubical offices at the unit costs and the same percentage of assignable space as was achieved in the Mathematical Sciences Building, our construction contract amount would have been $1,540,000 higher and the total project cost would have been $1,122,000 higher. . . .*
>
> *We currently have about 330 people in the building, none of whom have private offices. Therefore, all of us share the open space. No major problems have developed as far as space is concerned. The major difficulty we have is laying out new configurations for furniture arrangements as the composition of the staffs change. This is time consuming. The actual reconfiguration is accomplished over weekends using labor from Physical Plant to place the furniture in its new locations. The configuration costs are minimal, being the labor cost and the telephone relocation costs.*

Mr. Wade further stated that they have utilized the open-office concept on three additional projects: an office complex at a regional campus, a portion of a new engineering-research facility, and (currently in design) a building for the state chemist. On the third project, Mr. Wade commented that because funds were limited, the state chemist agreed to the open-office concept, possibly because he wanted the most space possible for the funds available.

Mr. Wade continues: "I feel we are saving about $30,000 a year in major and minor remodeling costs. In terms of original cost including furnishings, I feel conventional construction is one-third more expensive than a building using the open space concept."

"*Openness—Airiness.* These terms describe the visual impact on the visitors to the Administrative Services Building. This impact is made because of the absence of interior walls or fixed partitions. According to the office landscape concept, walls tend to impede work flow, communication, and organizational change."[23]

There it is! Open-space planning is certainly not the complete answer to the total building needs of a university or college. But for certain situations it does appear to offer a chance to increase efficiency and to save money at the same time. The problem? Reluctance on the part of the school to try something new and reluctance on the part of individuals to sacrifice the privacy and prestige of a personal office.

## Determining Method of Contracting

Before the Program of Requirements is finalized, it would be well to determine by what method the project is to be contracted. The method used would probably not influence the functional arrangement of the building and for that reason might not seem important to the committee working on the requirements for the building. But the purpose of a Program of Requirements is to let the architect know what the school wants. If the school desires to use a particular method of contracting, the architect should know so that his contract documents can be prepared to facilitate the preferred method. A thorough discussion with the architect of the various ways by which the project could be contracted might save the school both time and money. When the decision is made as to the method of contracting to be used, it should become a part of the Program of Requirements. When that is done, the decision is made official and the architect can proceed with assurance.

There are several ways a project might be contracted for. However, many schools do not have much of a choice. Often they are restricted by statutes or by governing board policies as to how their construction work is to be contracted. Because of the ever-increasing costs of construction, some governing bodies have allowed their schools to use different methods of contracting in the hope that money can be saved. Some of the methods will be briefly discussed.

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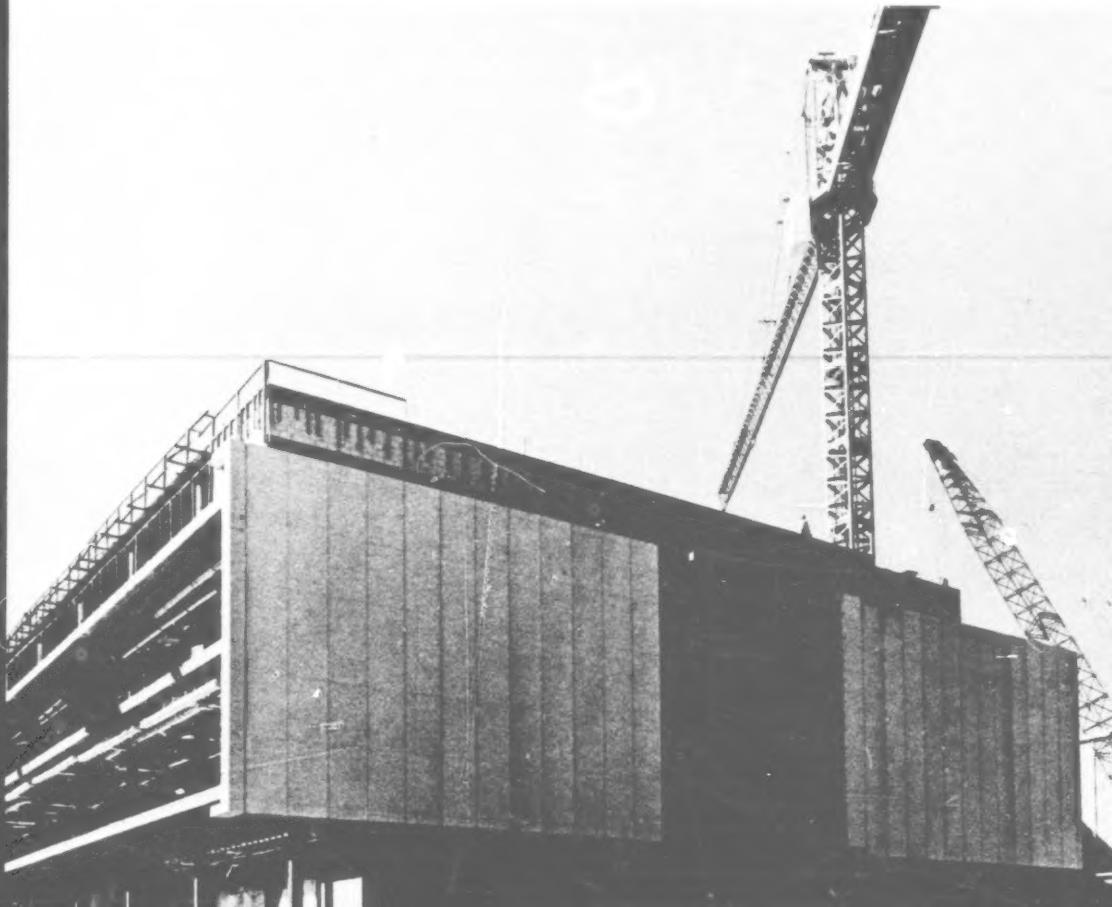
[23] *Information Booklet*, Purdue University.

**Negotiated Contract.** Some schools can negotiate a contract. This involves selecting one firm and sitting down with its principals to arrange a mutually satisfactory contract. It is quick and easy and is sometimes a desirable thing to do. However, schools often operate under laws or policies that would prohibit negotiating a contract except under most unusual circumstances.

*We feel Negotiated and Cost Plus Contracts tend to make the architect less productive and often produce sloppy, delayed, or incomplete plans. Many architects suggest the approach of negotiated or cost plus contracts as the preferred contract approach. One should ask himself why. The theory is that you the Owner will save money, save time, and get a better job since there is not as much incentive for the contractor to cheat on the project. We feel a major reason architects push these contractual arrangements for projects, however, is that it makes their job easier and costs less in architectural office*

Several methods may be used in constructing a building. The method to be used should be determined before actual planning commences.



*time, particularly drafting, since generally the plans need be less complete. General contractors like it, of course, since it essentially guarantees them a specific profit. We feel the only real advantage to an owner in using cost plus or negotiated contracts is the element of time. If a project is on an emergency or crash basis and needs to be started before plans can be completed, then a cost plus or negotiated contract may be the answer.*[24]

**Cost Plus a Fixed Fee.** This method works very well on relatively small projects. Using this method, the owner can select a contractor of proven ability and integrity. The school agrees to pay for all labor, materials, equipment, salaries, and the like, and the contractor agrees to complete the project for a mutually agreeable sum that includes his profit. The contractor will be paid only the amount agreed upon regardless of what the other costs may be (unless, of course, the school increases the scope of the project). Sometimes, it is advantageous for the school to do all the purchasing of materials and equipment, and at other times it might be better to have the contractor do the buying. In the latter case, the contractor would submit to the school all receipts and records of purchases and expenditures relating to the project at the same time he submitted his request for payment.

The cost-plus method would involve an architect or an engineer, either an outside professional or a school employee, to design the project; a contractor to build it; and school personnel, most likely and logically in the Department of Physical Plant, to inspect and do the necessary supervision and administrative work. Bids may even be taken—if that is a requirement. The competitive bidding would be to determine the contractor who could fulfill the requirements at the lowest fixed fee.

**Force Account.** This method works well on smaller projects, particularly on alteration jobs. It works especially well at a school where the Physical Plant Department can administer and supervise the work. The purchasing department could buy the needed materials and equipment, and Physical Plant would do what work it could with its own personnel, employing additional help as needed. An alternative method is for Physical Plant to supply only supervisory personnel and for all labor and trades on the project to come from outside the school. Many state schools are prohibited by law from doing construction projects costing over a specified amount. Where policy will allow it, and adequate school personnel are available, this method has much to recommend it.

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[24] Peter P. Welanetz, P.E., Director of Physical Plant, Williams College, Letter to Author, 8 August 1975.

**Single Bid (Lump Sum).** This is perhaps the most commonly used method of contracting. It involves advertising for bids and awarding a contract to a general contractor who then assumes overall responsibility for the total project. The contract is awarded to the low bidder. Occasionally the low bidder will discover after the bid opening that he has made a mistake in putting his bid together. If it is a substantial amount, he may ask permission to withdraw his bid. If an honest mistake has been made, most schools would allow the bidder to withdraw his bid, but sometimes he is penalized. "If the contractor can prove an honest and substantial error, he is allowed to withdraw. We occasionally suggest that he refrain from bidding future jobs."[25]

"If a contractor can prove he made a substantial error, he may be allowed to withdraw his bid. If this happens, the project would be rebid."[26] "If contractor can prove honest and substantial error within five days after bid opening, bidder is released from proposal. After second similar occurrence within a 2-year period, contractor is disqualified for a year."[27] "The state has allowed a bidder to retract when the error is an obvious one, but he was not allowed to do so without forfeiting his bond."[28]

Generally, bids are solicited by advertising in local and state papers for a minimum of three times at one-week intervals. For the school, one principal advantage of the single-bid system is that it gives the general contractor the responsibility for coordinating the work of all subcontractors. This makes it easier for the school to supervise the work. One disadvantage is that it necessitates advertising for bids. The low bidder might be someone with whom the school would rather not do business. Where bids can be obtained from a selected group of general contractors, this objection to the system is overcome. "Generally we bid and award contracts to one firm. We have obtained bids from prime sub-contractors and either handled them as separate contracts or assigned them to a general contractor. This has usually created more problems, delays, and cost than lump sum contracts."[29]

"Taking all things into account, we feel that we have had the greatest success with single overall bid contracts by a selected list of bidders (General Contractors)."[30] "One bid—one contractor is the only legally authorized method, so we have no experience with others."[31] "Some projects at the university are done on a one construction firm basis, while some are done through awarding contracts to three major contractors—general, electrical, and mechanical. We found it more satisfactory to use a single contractor for the overall project, which, of course, gives a single point responsibility."[32]

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[25] Ronald T. Flinn, University Engineer, Michigan State University, Response to Author's Questionnaire on Planning and Construction, 1975.

[26] Kenneth J. Hollett, Director of University Physical Planning, University of South Florida, Response to Author's Questionnaire on Planning and Construction, 1975.

[27] Richard A. Eustis, Director of Physical Facilities, University of Maine, Response to Author's Questionnaire on Planning and Construction, 1975.

[28] Wayne McMurtry, Director of Administrative Services, University of Southern Colorado, Response to Author's Questionnaire on Planning and Construction, 1975.

[29] Calvert W. Audrain, Director of Physical Planning and Construction, The University of Chicago, Response to Author's Questionnaire on Planning and Construction, 1975.

*The university awarded contracts to several Plumbing, Mechanical, and Electrical Contractors. On large projects, we have found that often one contractor will finish before another and request acceptance of his work. This creates problems. We have now established a practice that one contract will be awarded for all phases of the work regardless of the size of the project; and then we do not have this acceptance problem, and we do not have the problem of coordinating sub-contractors. Under this plan, we find that you need to limit the percent of add-on for the general contractor to handle change orders which may occur in one of his sub-contractor's contracts. Where no limit is set such as 5 percent, 7 1/2 percent or even 10 percent, the general contractor may add as much as 15 or 20 percent for his overhead in profit to an item being added to his contract by one of his sub-contractors where the general contractor or his firm will not spend any time or effort other than the signing of the change order. The amount of the add-on percentage for change orders pertaining to work performed by subcontractors should be included in the paragraph of the specifications where it states that one contract will be awarded for all phases of the work covered by the specifications. We highly recommend one contract for each project.*[33]

Private schools and other schools not required by law to openly advertise for bids have an advantage in seeking bids if they choose to use it. They can compile a select list of contractors that the school would be glad to have work on the campus. Each selected contractor would be required to prequalify with the school. The prequalification form that each contractor would be required to complete would include a statement from a bonding company on the bonding capacity of the contractor, a list of the contractor's assets and liabilities, his available equipment, current projects, personnel, and many other statistics that would help the school to judge the firm's ability to perform. This would enable the school to determine the size of the project that each contractor could safely bid. Thus, the school could have a list of bidders qualified to bid on projects costing one million or less, another list containing the names of firms qualified to bid on projects costing up to three million, and still another list, consisting of those who could bond and safely handle projects up to six million. There might be a small list of contractors with unlimited bonding capacity who could safely handle any size job or jobs that the school might have. This system has the advantage of giving the school prior assurance that the low bidder is acceptable, that he is well qualified, and that he will have no trouble furnishing a 100 percent performance bond. Prequalification forms must be reviewed annually, for the affairs of a contracting firm can change rather suddenly.

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[30] Peter P. Welanetz, P.E., Director of Physical Plant, Williams College, Response to Author's Questionnaire on Planning and Construction, 1975.

[31] Frank A. Kopf, Director of Physical Plant, State University of New York at Albany, Response to Author's Questionnaire on Planning and Construction, 1975.

[32] Harold C. Babcock, Director of Physical Plant, University of Oregon, Response to Author's Questionnaire on Planning and Construction, 1975.

[33] Raymond Halbert, Director of Physical Plant and Construction, University of Missouri, Response to Author's Questionnaire on Planning and Construction, 1975.

**Three-Bid System.** This system is so called because it normally involves getting separate bids from general, mechanical, and electrical contractors and having school personnel or someone employed by the school coordinate the work. Most often, the mechanical and electrical low bidders are assigned to the general contractor who assumes responsibility for coordinating all the work. The separate-bid procedure can be expanded to other phases of the project if desired (e.g., site development, masonry, painting, and furnishings). This system has the advantage of largely preventing "bid peddling," and for that reason, most subcontractors like it. The system is popular and is used quite extensively, but some who have used it have subsequently turned to other systems when possible. The problem of coordination could be the biggest objection to its use. "Our state uses a three-bid system (general, mechanical, and electrical). I dislike this system because of lack of responsibility and coordination, but the Board of Examiners seems to insist on this method."[34]

*We now generally bid the project with three or four prime contractors. This would be a separate contract for general construction work, a separate contract for mechanical construction work, one for electrical construction, and one for the elevator work. This still places the burden for coordination of the construction on the architect, and the state will not pay additional fees for contract coordination, which generally results in his not being able to spend sufficient time on supervision to properly coordinate the various con-*

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[34] A. A. Van Teylingen, Director of Facilities Planning, Montana State University, Response to Author's Questionnaire on Planning and Construction, 1975.

*tracts. Because of this, my last two building projects have been bid with all work under one contract, which was bid by a general contractor. Mechanical and electrical contractors in our area object to this method because the general contractor sometimes shops for a low mechanical bid after he is awarded a contract. To prevent this, we insist that the general contractor name his mechanical, electrical, and elevator sub-contractors in his bid proposal.*[35]

*We award multi-contracts. Each prime contractor (general, plumbing, heating, electrical) bids with the university. One contractor, usually the general, is designated the project expediter. It is his responsibility to schedule the work of the other prime contractors. This system works well when the general contractor is proficient and well organized and when the other contractors are cooperative. The system assures the other prime contractors—Plumbing, Heating, Electrical, etc., that their bids will not be shopped. When contractors are not organized, proficient, and cooperative, the project can experience delays, and quality can suffer. Several contractors do not like this system as it reduces their control of the project. Contracts are more difficult to administer because there is no single party to hold responsible.*"[36]

"We have awarded electrical, mechanical, and general on a few projects of less than $200,000 to get projects within budgets. It causes more work for the Physical Plant Department and more bookkeeping, but it is acceptable."[37]

"Single bid is used on small contracts (possibly up to $50,000 or $75,000). On larger contracts, separate contracts are awarded for General, Electrical, and Mechanical. Sometimes, the Mechanical is split with separate contracts—one for plumbing and another for heating, ventilating, and air-conditioning. Separate contracts are awarded for major equipment items such as kitchen equipment, bleachers, fixed seating, etc. This system works for us."[38]

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35. George C. Money, Director of Physical Plant, University of Nebraska Medical Center, Response to Author's Questionnaire on Planning and Construction, 1975.

36. Charles C. Braswell, Director of Physical Plant, North Carolina State University, Response to Author's Questionnaire on Planning and Construction, 1975.

37. Fred A. Day, Director of Physical Plant, New Mexico State University, Response to Author's Questionnaire on Planning and Construction, 1975.

38. K. S. Hayter, Director of Physical Plant (retired), South Dakota State University, Response to Author's Questionnaire on Planning and Construction, 1975.

"Our latest construction was a remodel job. We acted as General Contractor, since it was a small job. We sub-let mechanical, interior decorating, and carpentry. This worked well in our situation because of the close working relationship of all concerned."[39]

"We have sometimes hired a contractor to act as our agent for construction. This gives us excellent control over every detail of construction, and I like it very much. However, I am not sure whether or not it saves us money in the long run."[40]

"By law we must have a prime contract for (1) general work, (2) plumbing, (3) heating and refrigeration, (4) ventilating, and (5) electrical. Each contractor is a prime, coordinated by Southern Illinois University forces or by the Capital Development Board (a statewide organization for planning and construction of capital improvements). We believe this method slows work and makes costs higher, but it is politically viable."[41]

"I prefer multiple contracts with the general contractor being responsible for coordination of work by all contractors. Separate contracts for General, Mechanical, Electrical, Audio Visual, Furnishings, Landscape."[42]

*Separate contracts, in practice, have placed our field engineers in the role of construction superintendents, where they essentially perform the duties of a general contractor. Due to the fluctuating work volume, we cannot justify the establishment of a work force large enough to properly manage such an approach. Inspection quality falls off appreciably, since our staff efforts are diverted into the supervisory role rather than inspection. Single contracts, after separate bids, occasionally generate bickering over a balky assigned sub-contractor; but this is normally a manageable situation. However, this does require more inspection manpower. Single bid and subsequent award is the preferred method. We acknowledge the merit of having the major subcontractors listed on the bid form and require this approach when using single bids.*[43]

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[39] Kenneth E. King, Director of Physical Plant, Goshen College, Response to Author's Questionnaire on Planning and Construction, 1975.

[40] John H. Switzer, Manager of Plant and Purchases, Earlham College, Response to Author's Questionnaire on Planning and Construction, 1975.

[41] A. W. Blass, Director of Physical Plant, Southern Illinois University at Carbondale, Response to Author's Questionnaire on Planning and Construction, 1975.

[42] Lloyd Durow, Director of Physical Plant, Washburn University of Topeka, Response to Author's Questionnaire on Planning and Construction, 1975.

[43] Ronald T. Flinn, P.E., University Engineer, Michigan State University, Response to Author's Questionnaire on Planning and Construction, 1975.

There it is! Some like the three bid (separate-contract) system; some do not. Some use it only because they are required to do so. Others have tried it and gone to some other method. It is obvious that the system has merit but equally obvious that a school that expects maximum results from the system must be willing to provide sufficient personnel to supervise and coordinate as well as inspect.

**Fast-Track System.** For the last thirty years or so, it seems, everything has conspired to increase building costs. Inflation has caused construction to rise at such a rapid rate that the cost of a building could increase by more than $100,000 while school personnel debate what they want and what architect they would like to have design it. Another factor has been that school buildings have become so large and complex that large numbers of people of all kinds of persuasions become involved. The democratic process requires that each person have a chance to express his own views in considerable detail and to question and debate most of what each of the others has to say. This isn't all bad! In fact, such procedure will most likely produce a more functional building. But with construction costs increasing substantially each year, the time factor becomes a matter of real concern.

In an effort to reduce the time between inception and occupancy, many schools have been authorized by their governing bodies to try different systems of contracting—systems that hopefully could remove some of the restraints imposed by the conventional way of programming, planning, and building.

Fast tracking is one of those systems. Richard A. Eustis, director of Physical Facilities, University of Maine, states,

> *Fast track is a process whereby construction is started on certain phases of the projects in advance of the completion of entire plans for the project. For instance, the plans for the foundations are completed, and construction is started prior to the completion of the architectural, mechanical, or framing plans. The framing plans might then be completed and structural work started after the foundations are completed without the architectural or mechanical plans being completed.*[44]

John K. Armour, Physical Plant director, York University, writes, "When a university, for the purpose of fast-tracking a project, retains a company providing construction management services, a mutually acceptable list of pre-qualified firms for all trade work is prepared; and tender calls are then geared to the design and construction schedule."[45]

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[44] Richard A. Eustis, Director of Physical Facilities, University of Maine, Response to Author's Questionnaire on Planning and Construction, 1975.

George C. Money, director of Physical Plant, University of Nebraska Medical Center, indicates that the fast-track method has been considered but that it is very difficult with federal funding and with state funding and restrictions on planning and contract approvals.[46] James A. Ward, director of Planning and university architect, Duke University, writes that they are trying the construction-manager approach to allow fast-tracking, but they do not have enough experience to evaluate.[47]

It seems logical that a successful fast-tracking project could save time and money. But its success would probably depend on several factors: (1) a really good and complete program, (2) an experienced and cooperative architect, (3) an experienced and highly capable project coordinator, (4) adequate financing, and (5) the willpower to resist extensive changes in program requirements and in design after orders for materials have been placed and construction started.

Turnkey System. This system is also occasionally called a "Package Deal." It has variations, but essentially it consists of the owner's telling a design-builder what is wanted. The design-builder then prepares plans and constructs the project. When he has completed the project, he hands the key to the owner. Under this system it would be very advantageous for the school to prepare a detailed program of requirements. Also, extreme care should be exercised in selecting the design-builder. The school does not have the same controls and safeguards that it would have under more conventional methods. A firm that did not have the school's interest at heart could cause some rather difficult problems. But, when all is said and done, it is hard to imagine how a complex academic building could be planned and built under this system. It might work all right for a warehouse, a parking structure, or even a dormitory. The system could provide a facility in a hurry and, perhaps (if everything went right), at a savings. However, problems might come later, when it was discovered that the facility did not meet the users' requirements.

George C. Money, at the University of Nebraska Medical Center, wrote concerning some of his experiences.

*The turnkey warehouse job resulted in a contractor selling his service as a*

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[45] John K. Armour, Director of Physical Plant, York University, Toronto, Canada, Response to Author's Questionnaire on Planning and Construction, 1975.

[46] George C. Money, Director of Physical Plant, University of Nebraska Medical Center, Response to Author's Questionnaire on Planning and Construction, 1975.

[47] James A. Ward, Director of Planning and University Architect, Duke University, Response to Author's Questionnaire on Planning and Construction, 1975.

*construction coordinator. His main interest was selling the metal building. Many site problems developed. The building was designed for gas-fired heaters and about the time the building was ready for occupancy, it was discovered that the local utility company would not supply gas. So electric units were purchased and installed at considerable extra cost. This caused delay in occupying the building because the proper sized electrical service was not available.*[48]

Money went on to list other problems, but this one is enough to emphasize the necessity of not rushing into a contract with any person or firm simply because they say they can save the school a lot of time and a bundle of money. Almost anyone could build for less money if he were allowed to write his own specifications. Undoubtedly the system has merit, and for certain types of structures it would probably be the best system to use. But it is questionable as to whether it is a good system for planning and constructing most university and college buildings. James A. Ward, director of Physical Planning and university architect, Duke University, stated, "We tried the turn-key approach for design and build, but this presented many problems for the owner."[49] Lawrence L. Ketchen, director of Facilities Planning and Construction at Tufts University, relates, "We have tried the design-construct (turn-key) on two projects. One worked very well. On the other, I had to finally get in and ramrod the job. Design-Construct needs lots of watching to insure a good job."[50]

Design-Construct. This system is closely akin to the turnkey system. It involves securing a single firm to do all the design work as well as the construction work. Presumably the same advantages and disadvantages would apply here as for the turnkey system. Richard A. Eustis, University of Maine, summed up his comments on fast-tracking and design-build by saying, "Both of these methods permit the overlapping of the design and construction time periods. We do not believe this savings in time is worth the loss of control over the projects which occurs with these methods."[51]

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[48] George C. Money, Director of Physical Plant, University of Nebraska Medical Center, Response to Author's Questionnaire on Planning and Construction, 1975.

[49] James A. Ward, Director of Planning and University Architect, Duke University, Response to Author's Questionnaire on Planning and Construction, 1975.

[50] Lawrence L. Ketchen, Director of Facilities Planning and Construction, Tufts University, Response to Author's Questionnaire on Planning and Construction, 1975.

[51] Richard A. Eustis, Director of Physical Facilities, University of Maine, Response to Author's Questionnaire on Planning and Construction, 1975.

**Construction Management.** As already stated, everyone who has had any building to do has tried to devise some way to get more "building for the money." Just about every possible method that could legally be tried has been tried. Of these various methods, one shows a great deal of promise. It is generally known as "construction management."

While it is a fairly new concept in this country, it has already proven itself practical and economical, not only in industry, but also on university campuses. Much has been written on the subject, and construction-management seminars have been held in various sections of the country. No effort will be made here to go into detail, but it is believed that the concept is sound and will be used by more schools as its techniques and potential for savings in time and money become better known.

Briefly, construction management is another method designed to shorten the time it takes to plan and build a project. However, it varies in a few important ways from some of the systems already discussed. One of the important differences is the use of a construction manager. He is brought into the program at the very beginning, and he is involved at all stages of planning and construction. He has nothing to sell, and he does not receive any commission. Nor does he profit from the use of any material or equipment. He is completely free to represent the school paying his salary. He is there to see that the entire project is coordinated so that time is saved and money well spent and so that the school gets a well-built and functional facility. He performs about the same functions as a construction superintendent with one important difference: he works with the architect/engineer in the preparation of plans and specifications. Thus, from the very beginning, a team effort is developed involving the architect, engineers, and the construction manager.

The construction manager position might be filled in at least three ways: (1) by a single individual employed by the school, (2) by school personnel, and (3) by employing a firm specializing in project management. The first would involve finding a man with the kind of experience that architects, engineers, and construction people would respect. In addition, it would certainly help if he were a good administrator and excellent in public relations. The second method would probably be practical only at a school with a continuing building program and a strong commitment to construction and management principles. The third method would probably be desirable if there were several buildings or an entire new campus to do all at the same time. The chosen firm would have demonstrated expertise in construction management, and they would and could represent the school in a highly professional and able manner.

Subcontractors can be selected by competitive bidding, but they are selected by the owner, not by a general contractor, and their work is supervised and coordinated by the construction manager. The manager, by working closely with the architect, can let subcontracts by phases as the plans become available, without having to wait for complete contract documents. This method could save considerable time between the start of planning and the end of construction.

The Commonwealth of Massachusetts, through the Bureau of Building Construction, used a project management concern as consultants during the planning and construction of the University of Massachusetts' campus at Boston. The Planning and Development Department was directly involved with the Bureau of Building Construction and with the project management concern. The Physical Plant Department assisted where possible. According to Charles O. Spaulding, director of Physical Plant, University of Massachusetts, Boston, the project involved a rather extensive site development and the construction of several academic and related buildings. Spaulding further stated that the actual planning work done by the seven designers (involved for six buildings and the site work) was begun in January 1970 and that the campus opened for approximately 6,000 students in January 1974. The chief saving in time was effected in the planning process, which was completed for all practical purposes within one year, with contracts going out to bid in late 1970 and early 1971.[52]

Arthur R. Freedman, P.E., director of Facilities Development at the University of Pennsylvania, states, "The University in all its major construction projects, is now proceeding on the basis of Construction Management techniques. This does not necessarily mean that we always hire a Construction Management firm, as our own staff is professional and competent in many of the facets needed to carry out a successful major project."[53]

Terry L. Suber, director of Physical Plant at Colorado State University, indicated that they were well pleased with one of their projects being done by Construction Management principles. He further indicated that a great deal of the success of the project was due to their very capable construction manager.[54]

G. A. Norton, director of Physical Plant, University of Massachusetts, Amherst, wrote,

> *I cannot comment on the University's experience in this regard [Boston*

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[52] Charles O. Spaulding, Director of Physical Plant, University of Massachusetts, Boston, Letter to Author, 16 May 1975.

[53] Arthur R. Freedman, P.E., Director of Facilities Development, University of Pennsylvania, Letter to Author, 1 May 1975.

[54] Terry L. Suber, Director of Physical Plant, Colorado State College, Telephone Conversation, 19 May 1975.

*campus], but I can comment on it from 20 years experience in industrial construction with the Monsanto Company. In short, I feel that it is a very acceptable and efficient way to run a major construction project; however, as you point out, the secret of success is to get the right man for the job. It takes an unusual person [for construction manager] with a very broad construction background and with proven abilities not only in technical knowledge but also in the administrative and accounting areas—much more than the normal Construction Superintendent.*[55]

It is not known how many schools have used construction management techniques, but the method has been used successfully by the three schools mentioned above. A school seriously concerned about the time and cost of building under conventional methods might want to investigate the construction-management concept to determine if it could provide at least a partial solution to those problems.

### Project Responsibility

It is desirable to have well-defined procedures for carrying out major building projects from inception to occupancy. There are many ways by which this can be done. On the following pages are three examples.

### Summary

Programming is an essential early step to good planning. However, some schools are still allowing their architects to do plans without the benefit of programs prepared by the school staff. Experience suggests that under no circumstances should an architect be allowed to proceed until he is supplied with a Program of Requirements outlining what is to go into a building and the important relationships between the various functions outlined. If careful programming is properly done, the school can save money and insure more functional buildings.

Many methods are used to select architects and engineers. Whatever method is used, a firm should not be employed without checking its professional qualifications and its desire to cooperate fully with school personnel. The size of a firm does not always indicate professional excellence. Many splendid architects prefer to keep their offices small so that they can give personal attention to their work.

There are many types of architectural contracts in use, but many schools have developed their own, often patterned after AIA contract forms. Whatever form is used, it should go into detail concerning the services to be performed and the amount and method of payment. It is an important and

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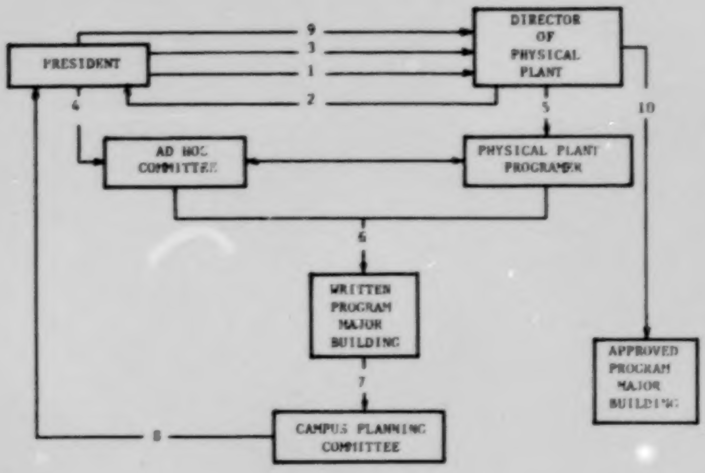
[55] G. A. Norton, Director of Physical Plant, University of Massachusetts, Amherst, Letter to Author, 29 April 1975.

## CHART 1

## START OF A MAJOR BUILDING PROJECT


PRESIDENT
DIRECTOR OF PHYSICAL PLANT
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3
1
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4
5
10
AD HOC COMMITTEE
PHYSICAL PLANT PROGRAMMER
6
WRITTEN PROGRAM MAJOR BUILDING
APPROVED PROGRAM MAJOR BUILDING
7
8
CAMPUS PLANNING COMMITTEE

1. President authorizes director of Physical Plant to begin the project.

2. Director of Physical Plant asks President to appoint an ad hoc committee of five to seven members from major building staff to program requirements.

3. President agrees.

4. President appoints a committee of seven to work with Physical Plant.

5. Director of Physical Plant appoints member of his Planning Office to assist ad hoc committee.

6. A written program of requirements is prepared.

7. The program is reviewed by the Campus Planning Committee.

8. When approved by Campus Planning Committee, the Program of Requirements is submitted to the President for review by himself and others.

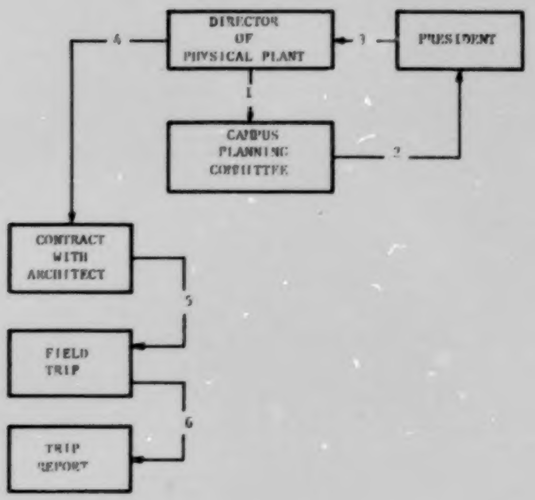
9. President notifies Director of Physical Plant that program as submitted or as amended is satisfactory.

10. Program is signed, dated, and bound and is ready for architect.

**Example 1. Procedure for a major building project from inception to occupancy. The method shown (a modification of the procedure used at Brigham Young University) may not fit the organizational structure of all schools, but is one orderly way of keeping things**

## CHART 2

## APPOINTMENT OF THE ARCHITECT


DIRECTOR OF PHYSICAL PLANT
PRESIDENT
CAMPUS PLANNING COMMITTEE
CONTRACT WITH ARCHITECT
FIELD TRIP
TRIP REPORT
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1. Director of Physical Plant discusses architects for the project with the Campus Planning Committee.

2. Campus Planning Committee recommends an architect to the President.

3. President approves selection of architect to director of Physical Plant.

4. A contract with the architect is prepared and executed.

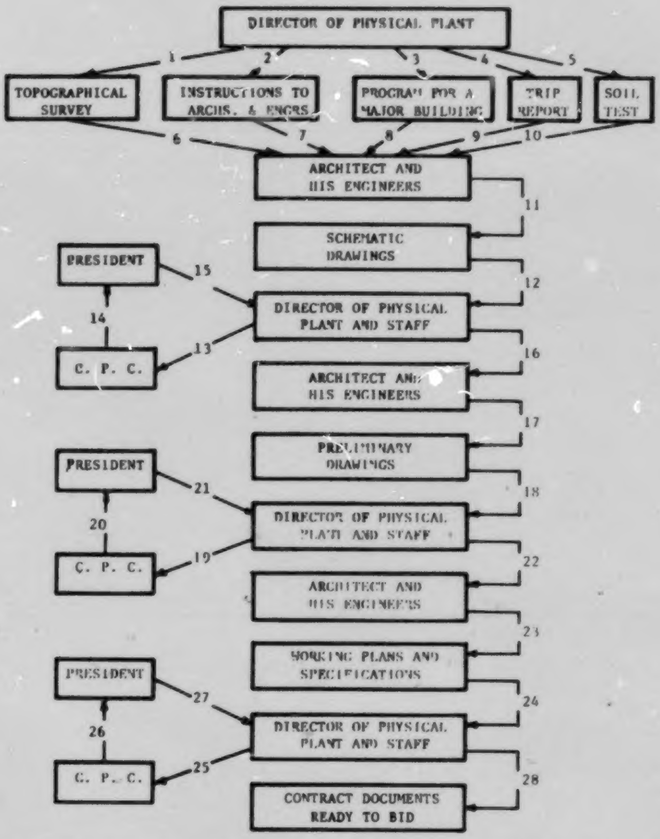
5. The architect, a member of Physical Plant, and a member of the ad hoc committee visit several similar projects that have been built within last five years.

6. A written trip report, with pictures, is prepared describing in some detail good and bad features of each project visited.

in proper channels and of doing what is essential for a carefully programmed, planned, and constructed project. The suggested order and the delegation of responsibility can be modified, but each planning process is important, and each, when carried out properly and carefully, will help insure a better project.

## CHART 3

## PREPARATION OF PLANS


DIRECTOR OF PHYSICAL PLANT
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TOPOGRAPHICAL SURVEY
INSTRUCTIONS TO ARCHS. & ENGRS.
PROGRAM FOR A MAJOR BUILDING
TRIP REPORT
SOIL TEST
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ARCHITECT AND HIS ENGINEERS
11
SCHEMATIC DRAWINGS
12
PRESIDENT
15
14
DIRECTOR OF PHYSICAL PLANT AND STAFF
13
C. P. C.
16
ARCHITECT AND HIS ENGINEERS
17
PRELIMINARY DRAWINGS
18
PRESIDENT
21
20
DIRECTOR OF PHYSICAL PLANT AND STAFF
19
C. P. C.
22
ARCHITECT AND HIS ENGINEERS
23
WORKING PLANS AND SPECIFICATIONS
24
PRESIDENT
27
26
DIRECTOR OF PHYSICAL PLANT AND STAFF
25
C. P. C.
28
CONTRACT DOCUMENTS READY TO BID

1-2-3-4-5. Before the architect begins work, he should have five items: a topographical survey, a set of instructions, a written program of instructions, a trip report, a soil test report.

6-7-8-9-10. The architect and his engineers are given the five items and authorized to start schematic drawings.

11. The architect submits several proposals or studies.

12-13. The Physical Plant staff, the ad hoc committee, and the Campus Planning Committee review and discuss these studies.

14. The Campus Planning Committee discusses various schemes and their recommendations with the President.

15. The President is satisfied and gives authorization to go ahead.

16-17. The architect is authorized in writing to proceed with preliminary drawings.

18. The architect submits preliminaries.

19-20-21. Same procedure is followed as for schematics.

22. The architect is authorized in writing to proceed with working drawings.

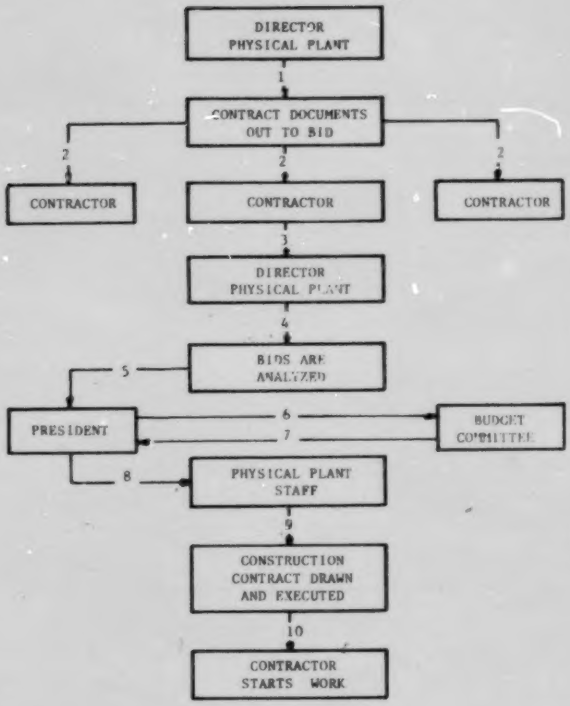
23-24. The architect submits advanced working drawings and specifications for checking and finally completed working drawings.

25-26-27. Final administrative approvals are obtained.

28. The project is ready to bid.

## CHART 4

## BIDDING THE JOB


DIRECTOR PHYSICAL PLANT
1
CONTRACT DOCUMENTS OUT TO BID
2
2
2
CONTRACTOR
CONTRACTOR
CONTRACTOR
3
DIRECTOR PHYSICAL PLANT
4
BIDS ARE ANALYZED
5
PRESIDENT
6
7
BUDGET COMMITTEE
8
PHYSICAL PLANT STAFF
9
CONSTRUCTION CONTRACT DRAWN AND EXECUTED
10
CONTRACTOR STARTS WORK

1-2. The project is submitted for bids to general contractors.

3. The contractors have four weeks to prepare bids which are opened and read aloud.

4. The three low bids are retained. The low bid is analyzed and the subcontractors are carefully checked.

5. If everything is in order, the President is notified.

6. A budget is prepared.

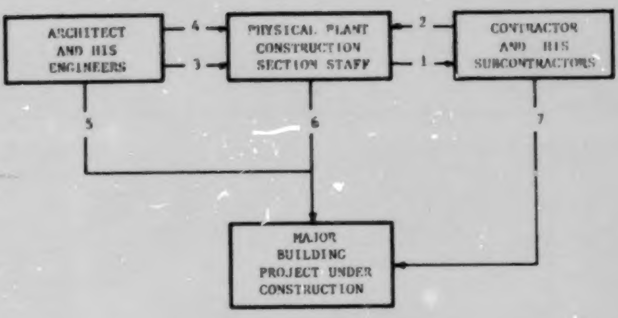
7-8. Budget is approved and Physical Plant is notified.

9. Physical Plant draws a contract and secures necessary signatures.

10. The general contractor is given a contract and authorized to begin work.

## CHART 5

## DURING CONSTRUCTION


ARCHITECT AND HIS ENGINEERS
4
3
PHYSICAL PLANT CONSTRUCTION SECTION STAFF
2
1
CONTRACTOR AND HIS SUBCONTRACTORS
5
6
7
MAJOR BUILDING PROJECT UNDER CONSTRUCTION

1. Physical Plant provides detailed inspection and keeps in contact with contractor and his subs every hour they work.

2. Contractor requests interpretation of plans and has contact with architect through Physical Plant.

3. Architect supplies shop drawings, in-construction drawings, selection of colors, etc.

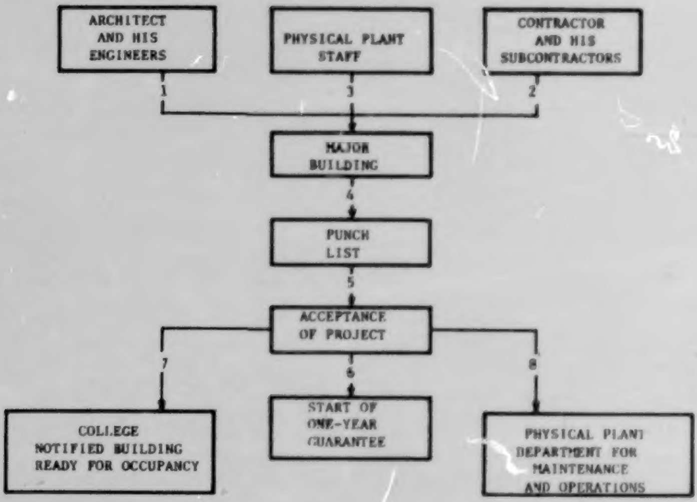
4. Architect works with contractor through Physical Plant.

5-6. When architect goes on job he is accompanied by a Physical Plant staff member or a Physical Plant building inspector.

7. The general contractor has a certain prescribed number of days to complete the project, and a liquidated damage clause is in his contract.

## CHART 6

## COMPLETION AND FINAL ACCEPTANCE

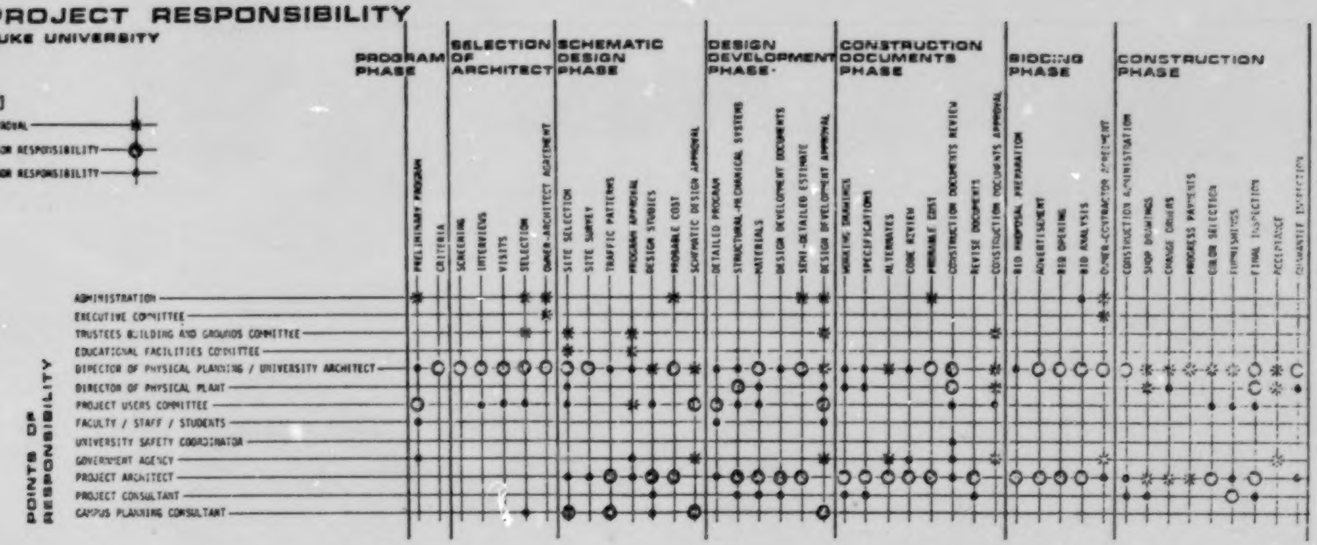

ARCHITECT AND HIS ENGINEERS
PHYSICAL PLANT STAFF
CONTRACTOR AND HIS SUBCONTRACTORS
1
3
2
MAJOR BUILDING
4
PUNCH LIST
5
ACCEPTANCE OF PROJECT
7
6
8
COLLEGE NOTIFIED BUILDING READY FOR OCCUPANCY
START OF ONE-YEAR GUARANTEE
PHYSICAL PLANT DEPARTMENT FOR MAINTENANCE AND OPERATIONS

1-2-3. The project is now substantially completed and the Physical Plant staff architect, and the contractor agree that it is time for a final inspection. A team composed of the architect and his engineers, Physical Plant personnel and the contractor and his principal subcontractors is formed, and a detailed final inspection is made.

4. A punch list of missing or unacceptable items is prepared and given to the contractor.

5-6. When the punch list is "punched out" another inspection is made. If everything is in order the contractor is notified that his one-year guarantee will start on a specified date.

7-8. After acceptance of the project the departments of the College that are to be included in the building are notified that they may occupy the building and Physical Plant begins the long, never-ending task of maintenance and operation.


ROJECT RESPONSIBILITY
UKE UNIVERSITY
ROVAL
OR RESPONSIBILITY
OR RESPONSIBILITY
PROGRAM PHASE
PRELIMINARY PROGRAM
CRITERIA
SELECTION OF ARCHITECT
SCREENING
INTERVIEWS
VISITS
SELECTION
OWNER-ARCHITECT AGREEMENT
SCHEMATIC DESIGN PHASE
SITE SELECTION
SITE SURVEY
TRAFFIC PATTERNS
PROGRAM APPROVAL
DESIGN STUDIES
PROBABLE COST
SCHEMATIC DESIGN APPROVAL
DESIGN DEVELOPMENT PHASE
DETAILED PROGRAM
STRUCTURAL-MECHANICAL SYSTEMS
MATERIALS
DESIGN DEVELOPMENT DOCUMENTS
SEMI-DETAILED ESTIMATE
DESIGN DEVELOPMENT APPROVAL
CONSTRUCTION DOCUMENTS PHASE
WORKING DRAWINGS
SPECIFICATIONS
ALTERNATES
CODE REVIEW
PROBABLE COST
CONSTRUCTION DOCUMENTS REVIEW
REVISE DOCUMENTS
CONSTRUCTION DOCUMENTS APPROVAL
BIDDING PHASE
BID PROPOSAL PREPARATION
ADVERTISEMENT
BID OPENING
BID ANALYSIS
OWNER-CONTRACTOR AGREEMENT
CONSTRUCTION PHASE
CONSTRUCTION ADMINISTRATION
SHOP DRAWINGS
CHANGE ORDERS
PROGRESS PAYMENTS
COLOR SELECTION
FURNISHINGS
FINAL INSPECTION
ACCEPTANCE
GUARANTEE INSPECTION
POINTS OF RESPONSIBILITY
ADMINISTRATION
EXECUTIVE COMMITTEE
TRUSTEES BUILDING AND GROUNDS COMMITTEE
EDUCATIONAL FACILITIES COMMITTEE
DIRECTOR OF PHYSICAL PLANNING / UNIVERSITY ARCHITECT
DIRECTOR OF PHYSICAL PLANT
PROJECT USERS COMMITTEE
FACULTY / STAFF / STUDENTS
UNIVERSITY SAFETY COORDINATOR
GOVERNMENT AGENCY
PROJECT ARCHITECT
PROJECT CONSULTANT
CAMPUS PLANNING CONSULTANT

Example 2. Form outlining "Project Responsibility." Created by Caudill, Rowlett, and Scott, Houston, Texas, master plan consultants for Duke University, it was modified by Duke to fit their situation. Submitted both by James A. Ward, director of Physical Planning and University Architect, and by Harry F. Ebert, director of Physical Plant, Rice University, former director of Physical Plant at Duke.

| Phase of Building Project | Those Involved in Decision Making |
|---|---|
| Development of the need for a building or facility | (a) Faculty<br>(b) Top college administrators |
| Initiation of a building project | (a) Top college administrators<br>(b) Board of Managers |
| Appointment of faculty-student building project committee | (a) College president |
| Set up program guidelines for the building project | (a) Faculty-student committee (building project committee)<br>(b) Planning engineer |
| Appointment of architect | (a) Campus architecture committee<br>(b) Top college administrators<br>(c) Board of Managers |
| Refinement of program development of schematic plans | (a) Architect<br>(b) Faculty-student committee (building project committee)<br>(c) Planning engineer |
| Approval of schematic plans, authorization to go ahead with working drawings | (a) Top college administrators<br>(b) Board of Managers |
| Details of appearance of furnishings | (a) Architect<br>(b) Faculty-student committee (building project committee)<br>(c) House Director (buildings and grounds)<br>(d) Campus decorating committee<br>(e) Top college administrators<br>(f) Board of Managers |
| Approval of architect's working drawings and specifications | (a) Buildings & Grounds Department<br>(b) Faculty-student committee chairman<br>(c) Planning engineer<br>(d) Top college administrators<br>(e) Board of Managers |
| Review of economies possible (if necessary) after bids are received | (a) Buildings & Grounds Department<br>(b) Faculty-Student committee chairman<br>(c) Planning engineer<br>(d) Top college administrators<br>(e) Board of Managers |
| Award of contract to builder | (a) Planning engineer<br>(b) Top college administrators<br>(c) Board of Managers |
| Follow up of construction | (a) Planning engineer<br>(b) Faculty-student committee chairman |

Example 3. Simplified chart of the building-planning process at Swarthmore College. (Submitted by Joseph E. Spafford, planning engineer).

binding contract, and it should be prepared by an attorney or carefully checked by the school's legal counsel.

Some of the best-spent money during the planning of a major building is that used to finance properly conducted field trips. A field trip should be properly organized and have the participation of the right people if its full value is to be realized. Arrangements should be made in advance with the schools to be visited, and sufficient time should be spent at each school to get all the required information. A questionnaire or checklist should be prepared in advance to insure that nothing of importance is overlooked.

Open-space planning (office landscaping) offers real possibilities for saving money initially and in future maintenance. The technique should be considered when programming and planning buildings in which large rooms can be made to serve varied activities and personnel. It would be especially suitable for office or business-type buildings.

There are several methods of contracting for construction. Each method has its advantages and disadvantages. A school and its architect should decide what method is to be used before actual planning begins.

# 4

# Planning Aids for the Architect/Engineer

Before an architect will proceed with the design of a facility, he must of course have a contract. This is an important document. It commits the owner to expend a considerable sum of money, and it commits the architect to expend a considerable amount of time and effort. If the architect is to accomplish the most for the school in the time he is working, the school should supply the architect with certain documents. These items, if carefully prepared, will enable the architect to prepare his plans in a shorter time; more important, though, they will help him develop plans better suited to the needs of the school.

**Programs of Requirements.** This is one document that a school should provide its architects. The subject of programming is discussed in some detail in chapter 3. Nothing further on the subject need be said here, except to reemphasize its importance and to recommend once more that some form of written program be given every architect commissioned either to develop plans for a new university or college building or to prepare plans for alterations to an existing structure. The emphasis has been on the architect, but it is equally important that a program of requirements be developed for the engineer commissioned to prepare plans for campus engineering projects.

**Instructions to Architects and Engineers.** This document is most often used to supplement the written program of requirements. It should contain things that are fairly common in the design of campus facilities and that need not be repeated in the individual programs. It should contain information on details that the school has standardized and wants its architects and engineers to use. It is a good place to present sketches and drawings of items the school wants done in a particular way. As an example, custodial closets are often inefficiently designed and located. A drawing in the instructions showing an efficient custodial closet would be of value to the architect and would ensure standard and acceptable layouts throughout the campus. (As a large percent of any Physical Plant maintenance budget is spent on the custodial operation, this is not an inconsequential matter.)

The document is especially important for a school doing a considerable amount of building and using several firms of architects and engineers. Without direction from the school, each firm might develop entirely different details pertaining to the same matter. This poses a problem for Physical Plant, who would not only be required to stock different types of maintenance items but would also need to become familiar with different operating procedures. If a school has "set notions" about how anything is to be designed or specified, the best place to insure compliance is to put it in a carefully documented set of "Instructions to Architects and Engineers."

Forty-two universities and colleges were asked this question: "Do you have a carefully prepared document of 'Instructions to Architects and Engineers' that is applicable to all jobs and used to complement program requirements on each major project?" Twenty-four said that they did, and eighteen said they did not. This is understandable because carefully preparing a really adequate set of instructions requires a great deal of work—perhaps more work than some feel they can afford to spend. And yet, such a document as a companion piece to the program of requirements is so important that it is certainly worth whatever time and effort is required to produce it. In one sense, a set of instructions to architects and engineers is like a master plan. It always seems to need revision to keep it current and to add subjects not previously covered.

No two schools would ever prepare such a document in the same way, nor cover the exact same subjects. To do so is not important. At the Fifty-Ninth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, held at the University of Cincinnati in 1972, a display of architect/engineer manuals was made. Many schools submitted theirs, and York University was judged to have the best of those exhibited. The manuals were all different in appearance and in text, but each had substantially the same purpose—to let architects and engineers know what was wanted of them in certain areas of campus development.

A document entitled, "Instructions to Architects and Engineers," prepared by the Department of Physical Plant at Brigham Young University and currently in use was first written in 1959. As of August 1973, it had been revised seventeen times. It is a sizable document and, of course, cannot be reproduced here. However, its table of contents is reproduced with the thought that it might generate ideas or serve as a guide to some school desiring to produce a document to serve the same or a similar purpose.

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**Space Standards.** In programming for new buildings, it is helpful for the chief programmer to have a set of room standards available. The average person does not have a very good conception of dimensions. If room sizes were determined by different individuals and ad hoc committees, there wouldn't be much consistency in the size of rooms serving similar functions around the campus. A better approach is to advise faculty and staff members on proper sizes for specific functions. Rather than ask a professor how large a classroom he wants, it would be better to ask him the following questions: (1) How many students will be seated in the room at one time? (2) How many chalk and tack boards are needed? (3) Will there be special requirements?

When answers to questions such as these have been received, any good programmer should then be able to determine the type of room and the minimal size needed.

It isn't difficult to establish space standards. Every university or college has classrooms, offices, and laboratories that are ample, but not excessively large, for the functions they serve. By measuring such facilities and dividing the square feet by the number of occupants they will adequately accommodate, the square feet per occupant can be determined. When several facilities of like nature are measured and averages are determined, some fairly dependable standards can be obtained.

Realistic standards that are approved by the school administration enable the programmer to treat everyone alike. Unless there is a good reason, no dean or department chairman should be given an office larger than that allotted another dean or department chairman. By the same token, unless there is a good reason, a general classroom to seat fifty students in the education building should not contain twelve square feet per student station while a comparable one in the science building has twenty square feet per student station. When approved standards are established, it is much easier to deal with the "squeaky wheel who is trying to get all the grease."

It is doubtful that any set of standards can be adopted that will fit every situation. Adjustment will need to be made to meet special problems. An engineering professor who must have a drafting table in his office would certainly need a larger office than a professor whose only need was for standard office equipment. A classroom that required chalkboards on each side of the room would need more square feet per student than a classroom requiring a chalkboard only at the front. However, it is recommended that all schools, large or small, develop their own set of space standards to facilitate consistent and economical planning and construction. When the architect has the results of such studies, he can proceed with confidence and without having to debate with a number of persons over room sizes.

The following list of standards might be adequate for some schools and totally inadequate for others. They were developed at Brigham Young University and form a base for determining room sizes. The list is incomplete and is given only to illustrate how such standards can be developed. Schools should develop room sizes to satisfy their own requirements, and they should not be unduly influenced by the basic standards of others. It should also be recognized that offices, like classrooms and laboratories, must be designed for their best use. A large office can be not only wasteful of space, but also inefficient, while a smaller office could serve the same function adequately *and* efficiently. Large-scale drawings should be made of offices, and the required furniture and equipment, drawn to scale, should be studied until the most efficient use of minimal space is achieved. The number of doors and the way they swing needs to be carefully studied. Windows and the shape of a room will often influence the number of square feet needed to make it efficient. Room sizes should be adequate, but to make them larger than necessary at a cost of from $40 to $50 per square foot is to waste someone's money.

### Standards

| Space | Furniture | No. of Persons | Net Sq. Ft. per Person |
|---|---|---|---|
| Standard Classroom | Tablet armchairs | 10- 40 | 15 |
| | Tablet armchairs | 41- 75 | 12 |
| | Tablet armchairs | 76-100 | 11 |
| Conference—Seminar | Tables and chairs | 10- 20 | 20 |
| Case Study (tiered) | Swivel chairs—continuous counter top | 50-125 | 18 |
| Lecture Room (tiered) | Fixed seating | 50-100 | 12 |
| | | 101-300 | 10 |
| Auditorium (tiered) | Traditional Seating | | 8 |
| Auditorium (tiered) | Continental Seating | | 9½ |
| Library | Reading Rooms | | 25 |
| Library | Stacks (1 sq. ft./15 vols.) | | |
| Dining Hall | Chairs and tables | | 15 |
| Accounting and Bookkeeping | Chairs and tables | | 28 |
| Business Machines Room | Chairs and tables | | 28 |
| Typing Room | Typing tables and chairs | | 28 |
| Shorthand—Office Practice Room | Secretarial desks | | 40 |
| Clothing Lab | Special furniture and equipment | | 60 |
| Food Lab | Special furniture and equipment | | 58 |
| Sculpture and Ceramics Lab | Special furniture and equipment | | 50 |

| | | |
|---|---|---|
| Art Painting Lab | Special furniture and equipment | 50 |
| Chemistry Lab | Lab furniture | 58 |
| Photographic Lab | Special furniture and equipment | 40 |
| Data Processing Room | Special furniture and equipment | 75 |
| Science Lab | Lab furniture | 50 |

| Suggested Office Sizes | Square Feet |
|---|---|
| For one person who occupies it part of a day | 100 |
| For one person, part of a day, with extra furniture, such as a drafting table | 125 |
| For a department head or someone who occupies it a full eight hours a day | 150 |
| For two persons, part-time | 150 |
| For an assistant dean or assistant director | 175 |
| For a dean or director | 200 |
| For a vice-president | 250 |
| For a president | 350 |
| One secretary, with space for visitors | 150 |
| Two secretaries, with space for visitors | 200 |

**Soil Tests.** In areas where the substratum is uncertain or unpredictable, soil tests are recommended. Occasionally the subsurface is such that one part of the building foundation rests on rock or gravel while other parts rest on sand or clay. Unless the architect and his structural engineer are aware of this condition, uneven deflection is almost sure to occur. It might not be so bad if the entire building settled at the same rate, but when one part settles and another does not, or when one part of the building settles at a faster rate than other parts, then walls crack, floors become uneven, doors drag, and structural failures occur.

When foundation conditions are not uniform, soil tests should be made by properly equipped and experienced soils engineers. These tests consist of drilling holes at the building site at depths and locations agreed upon by the architect, his structural engineer, and the soils engineer. These test holes could vary in depth from 25 to 125 feet, depending on the size and weight of the building and the subsurface conditions. A building of good size might require from four to eight holes, again depending on subsurface conditions. The cores taken from these borings indicate the type of material, its location, and its thickness. Laboratory tests are then performed on these cores to determine the bearing capacity of the subsurface at each test hole. Special attention is given to water problems and to the possible loss of bearing capacity because of water. It isn't too unusual for test holes to be free of water at the time of drilling and to have water rise in them later. Where groundwater rises and falls to a marked degree, it is good practice to place a piezometer in one or two of the holes and to check them over a period of time so as to have more accurate information on the rise and fall of the water table.

Final bearing capacities and foundation recommendations are generally calculated by the soils engineer and the structural engineer after the architect has completed his preliminary designs. By this time, the shape, mass, and weight of the structure is known.

The cost of the soil testing and engineering and of the laboratory work connected with it is not part of the architect's fee and must be borne by the school. Those schools located where foundation conditions are so stable and so uniform that such procedure is not necessary are fortunate.

**Field-Trip Report.** A field trip to see what other schools have done and a field-trip report properly prepared will be one of the best aids an architect can have in planning a building. It is an important step in planning that isn't used as often as it should be. The subject of field trips and field-trip reporting is discussed in chapter 3.

**Topographic Survey.** If a topographic map is to be of real value to architects and engineers, it can become a fairly complex drawing. It should contain, not only all information concerning surface features, but also those underground features that will have an influence on design. Normally, a good "topo" will show clearly the following: ground elevations or contours, bench marks, grid system (properly referenced), property lines, trees and other natural features, structures, utilities (with sizes and characteristics), manholes, and any other features or items that should be known by the planners. It is not enough merely to indicate a sanitary sewer; the size of pipe and direction of flow should be shown, and grades should be taken at the flow line in all manholes so that depth of sewer connections may be determined. If there are special places at which connections should be made, that information should be shown. Similar information should be included on utilities, underground and overhead. All work should be coordinated with the local municipality so that the project does not overload sanitary sewers, storm sewers, or power and other utilities. Otherwise there might be expensive last-minute changes.

A topographic map may be drawn at different scales and with different contour intervals, but normally scales of 1" to 40' or 1" to 50' with 1' contour intervals are satisfactory for building and site-development projects. For master planning, contour intervals of 5' and at a scale of 50' to 100' might be satisfactory.

Occasionally a topographic map is drawn using an architect's scale, but this should be discouraged. A topo is an engineering drawing, and an engineering scale should be used.

The amount of detail indicated above is not always necessary. For feasibility studies, a topographic map containing only basic surface features and elevations might be all that is necessary. Such a topographic drawing would probably also be sufficient for master planning and general campus studies. Regional planners studying large areas would not require the detailed information that an architect would need in siting and planning a building.

When a topographic survey does not require detailed information on underground structures or the characteristics of utilities, aerial topography has much to offer. Photogrammetric surveys reveal visible ground features, including contour information, quickly, accurately, and economically and at whatever scale and contour interval wanted. When more detail is needed, the photogrammetric process can be supplemented with information obtained by a ground-crew survey.

Ground crews have been used and are still being used to secure all the information needed to prepare topographic maps or drawings. This is so partly because aerial surveys and the methods and equipment used in plotting topography and ground forms are not as well known as are the techniques of ground surveys. Therefore, because of the value and desirability of aerial mapping, the following explanation of the principles, techniques, and equipment is given:

Photogrammetry. *Photogrammetry, the science of making accurate measurements from photographs, is based on three basic systems: acquisition of the aerial photography, establishment of ground control for the orientation of the photography, and the map compilation or measurement and recording of the photography.*

*All processes in photogrammetry are precision operations and an extension of the basic surveying concept. Accordingly, all instrumentation is basically surveying equipment. Thus, aerial-survey cameras, field-surveying equipment, and stereo plotting equipment are all manufactured by such leading survey equipment manufacturers as Zeiss, Wild, Kern, Santoni Nistri, and optical manufacturers like Bausch & Lomb. In modern-day mapping, measurements recorded in these instruments are very often dealing in units of microns so as to satisfy the accuracy requirements.*

*In general, the more accurate the map requirements, the lower the aircraft doing the photography will fly. Thus, to prepare a reconnaissance map such as a 7 1/2 minute Geological Survey quadrangle, the aircraft would be about 20,000 feet above the terrain to produce a photo scale of 1:40,000 from which the 40' contour maps will be compiled. If a one-foot contour map is required for a building-site design and location, the flight height will be about 1200' to 1500' above the ground to produce a photo scale of about*

*1:3000, which would allow drawing of 1"=40' to 1"=50'.*

*It is important to recognize that the contour interval, usually not the final scale of the map, controls the flight height and scale of the photography. Accordingly, the flight height is based on a C-FACTOR, which reflects a multiple times the desired contour interval to arrive at the flight height for the aircraft. A C-FACTOR may vary from 1000 to 2400, depending on the type of instrument used to compile the maps. The manufacturers make such recommendations.*

*After the map project is planned, the first requirement is to stake out the location of the ground-survey control. Then markers are placed over these points so that they will be visible on the photography. On large-scale photos for 1' contours, it may be necessary to paint crosses with only one-foot legs over a monument on the pavement or to place white plastic or paper crosses with only two foot legs in a field or open area. For high-altitude reconnaissance work, it may be necessary to use flagging three feet wide and with legs twenty feet long or longer. After flagging is established, it is necessary to secure the photography as soon as weather will allow. The actual ground-survey control work may be performed by either the client's engineer or the aerial contractor.*

*Most modern mapping surveys are performed using small economical, single-engine aircraft such as a Cessna 180, 205, or 206. Some are turbocharged so that when it is necessary they can reach altitudes in excess of 18,000 feet. If altitudes over 22,000 feet are required often, turbine-engine-modified aircraft such as Riley Rockets, Sky Nights, and Aero Commanders are used. Sometimes Lear Jets are used for extremely high altitudes.*

*Stereo plotters are used to read or measure the photographs. To do this it is necessary to know the exact altitude of the camera at the moment of exposure so it can be incorporated into the stereo plotter for orientation of the stereo pair (one photo in relation to the adjacent one). Field-survey data used for this purpose establishes the stereo model location of the premarked field-survey points on the photos.*

*There are many types of instruments for the preparation of topographic maps. The more sophisticated ones have a greater C-FACTOR, allowing us to fly higher, cover more ground, and require less field control but still give the same accuracy. Data is usually collected in the form of a map or graphical representation and is plotted manually by a highly skilled operator. Electronic scanning, numerical automatic recording, and analytical transformation into maps, graphs, volume computations, etc., have been developed but are very costly and as yet have not found their way into practical everyday map making.*

*One of the newer applications is orthophoto mapping. This is an instrumental method of transforming the perspective view of a standard photo-*

*graph (all original photos have displacements of images up to 10-25 percent of the measurable photo due to relief, tilt, and other perspective effects) to an orthographic view, so that accurate measurements can be made directly from the photo reproductions as from a standard map.*

*This orthophoto now gives a world of measurable map photo data for planners, engineers, designers, land developers, etc., which can be superimposed on the contour map. This can be a great time and cost saver in urban and more developed areas, where now the planimetric data does not have to be plotted and drafted. This is becoming a favorite tool for city planners and engineers.*

*As with every medium, there are advantages and disadvantages. The single most important advantage of photogrammetry is the time element. There is no practical way that many existing map programs, such as the Geological Survey, could be carried out without photogrammetry. This is true for smaller projects as well. For example, one mine that was surveying its active mine area took exactly one year in the field and in recording from beginning to end. Today, the area is 2 1/2 times as great and is being provided photogrammetrically in thirty days from beginning to end.*

*This time savings obviously is reflected in costs, which are reduced considerably. There is considerable cost in equipment for the photo process, but costs can still be reduced to as little as 25 percent of a purely field approach. Where the land areas are very small, say less than five or ten acres, it may be less expensive to prepare in the field; but time needed to prepare the final map may still be greater.*

*Finally, the accuracies vary from field prepared maps in the following manner. All the specific points surveyed in the field are within regular surveying accuracies, but the contours and data between the surveyed positions are either interpreted or of limited accuracy. An overwhelming volume of notes and data must be accumulated and interpreted to prepare the final product. In the case of the photogrammetric map, 90 percent of planimetric features are within 1/40 of an inch at map scale and the balance not more than 1/20 of an inch. The contours are 90 percent within ± 1/2 the contour interval, and all spot elevations are within ± 1/4 the contour interval. The balance of the contours and spots will not exceed double that variance. These accuracies are established by the U.S. Bureau of the Budget. Thus, by virtue of the photogrammetric system, there will not be small isolated variances. Everything on the maps is within a specific tolerance.*[1]

**Campus Grid System.** A campus grid system is a practical and easy method of locating buildings and other facilities. Anyone who has ever tried to locate

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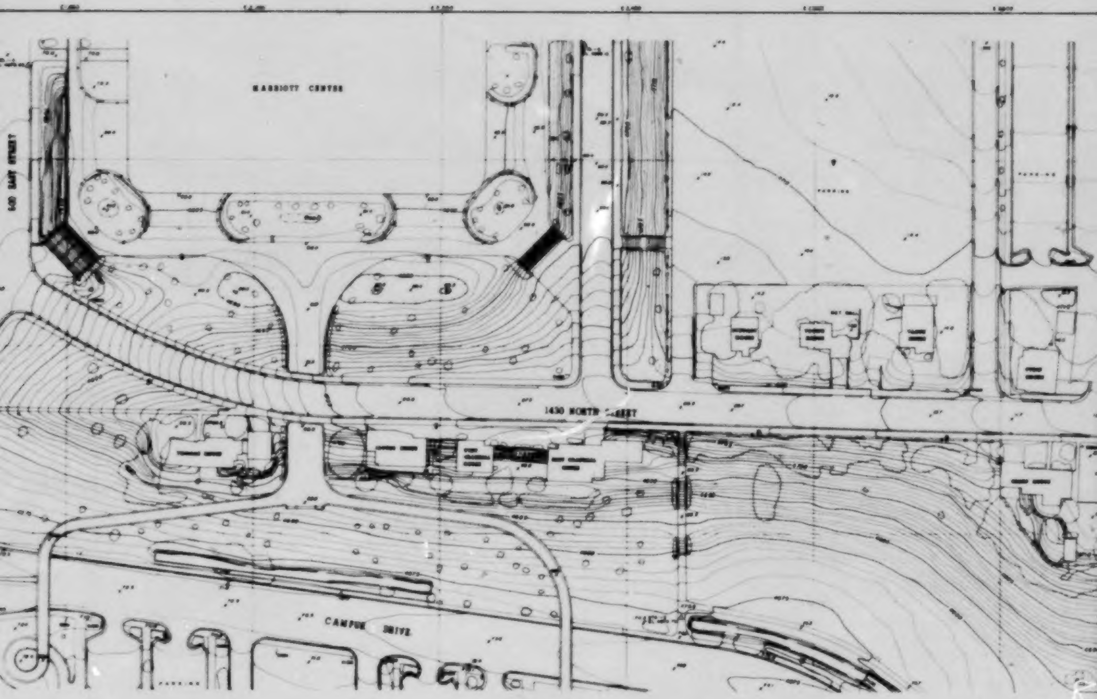
[1] Maurice X. Pia, Vice-President, Olympus Aerial Surveys, Inc., Salt Lake City, Utah, Letter to Author, 12 March 1976.



Aerial topographic map drawn with 1' contour intervals and at a scale of 1"=40'. (Flown and prepared by Olympus Aerial Surveys, Inc., Salt Lake City, Utah.)

a number of buildings, roads, and utilities on a plan understands how difficult it is to do unless there is a grid of some kind that everything can be referenced to. An architect designing a building must be able to show its location clearly so that it can be correctly positioned on the site. To do that accurately is difficult unless the campus has been surveyed and base lines established. A grid system can save time and money by making it possible to pinpoint physical facilities quickly and accurately.

A grid system is not difficult or expensive to establish; and once done, it will be of inestimable value to all engineers, architects, planners, and builders. A grid system can be laid out by establishing two base lines, one north and south and the other east and west. There is no certain place that base lines need to be located. It is only necessary to look the campus over and select the best location for the base lines. From these base lines, the grid may be established. There is no set distance that the grid lines need to be apart. That distance can be whatever is felt to be needed. A distance of 100 feet might be considered proper. Once the grid lines are established, each should be designated as so many feet north and east or south and west, etc. of the base lines. Such a system can be established by any licensed civil engineer.

There is no necessity for the grid system to relate to elevations. If it is desired, it may be done by placing monuments on the grid lines at known locations and marking each monument with its proper elevation. In that case, U.S. Geological Survey bench-mark data should be used.

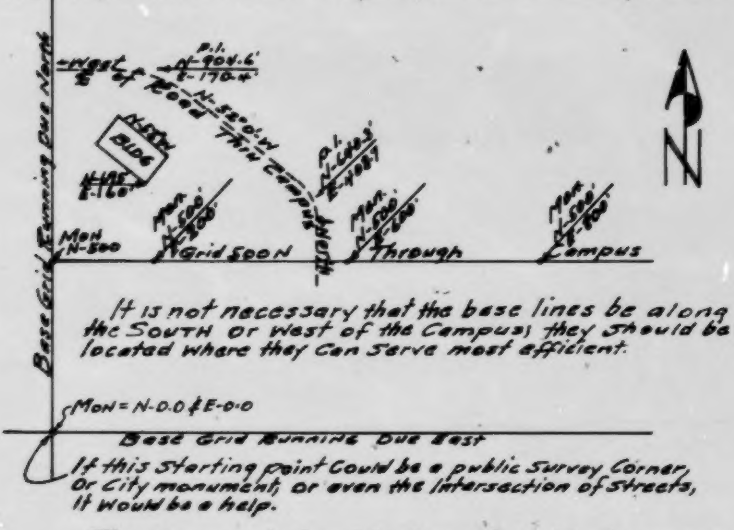
Once established, the grid system becomes another planning aid, because it allows the architect to reference his building so that it can quickly and accurately be staked on the job site. All plans, whether done by school planners or by outside architects and engineers, should be required to reference their plans to the grid system.

The following "Proposed Campus Grid System," by Carr F. Greer, Civil Engineer, Provo, Utah, illustrates and explains how such a system can be established and used.

PROPOSED CAMPUS GRID SYSTEM

REMARKS: In laying out, or establishing a Grid for a Campus it is best to Set it on a True North-South, East-West Direction, and where possible the main base lines should be at the periphery of the Campus, with a main grid line running thru the Campus at a location where it is readily accessable at all times, and with appropriate monuments set at intervals along this line and marked with their Grids and with U.S.G.S Elevation Set on these Monuments if desired.

All Buildings, Roads, pipe lines, monuments, and Other Structures Can be pin pointed by use of a Grid System and by the additional use of U.S.G.S. Datum for Elevations the basic information on all Campus facilities becomes permanent



It is not necessary that the base lines be along the SOUTH or West of the Campus; they should be located where they Can Serve most efficient.

If this Starting point Could be a public Survey Corner, Or City monument, or even the Intersection of Streets, It would be a help.

The Monument should be Concrete Set in the ground With the bottom below frost in Colder areas, with a 2"x2" Brass attached to a swedge bolt, Set flush with ground or grade and with the Grid and Elevation Stamped in the brass Surface.

**Planning Coordinator.** Experience has shown that most of the persons who are to occupy a new building would like to be able to meet and discuss their needs and ideas directly with the architect. Experience has also shown that this is impractical: it will produce so many conflicting statements and unauthorized requests that the results will be a frustrated architect and an unnecessary delay in planning. Preventing these problems is one reason for having an ad hoc planning committee to represent the great number of future users. But even this is not enough!

An officially designated school contact or planning coordinator should act as liaison between all school personnel (including members of the ad hoc committee) and the architect. The person designated as planning coordinator would vary from school to school because of the difference in the organizational structures of the schools. The logical choice would be the individual with the most responsibility for planning.

The purpose of this arrangement is to keep things in channels, so that a project can move through the various stages of planning in an orderly manner. There is no reason why certain persons could not meet with the architect at times, but such meetings should be made only with the full knowledge and concurrence of the coordinator. The logical sequence of contacts would be from the architect to the planning coordinator, to the ad hoc committee, to all other school staff. The reverse would be true. The Campus Planning Committee would become involved at certain times, but its contacts should also be through the coordinator.

> *Now that we have looked at some of the major factors which influence the relationship between the architect and the Physical Plant administrator, we can perhaps turn our minds to ways and means of making their working partnership as enjoyable as possible. First would be the establishment of a well-defined chain of communications which will be maintained throughout the project without exception or variation. Included in this should be the identification of the person in charge on both sides of the partnership and their assistants in order of authority and terms of reference.*[2]

It is certain that most architects would endorse the above statement and would consider such an arrangement a planning aid.

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[2] C. F. T. Rounthwaite, Architect, "Ideal Relationships Between the Architect and Physical Plant Personnel," Paper given at the Fifty-Fourth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Université de Montréal, 1967.

**Summary**

It is desirable that each architect commissioned to do a building be given the following as soon after signing the architectural contract as possible:

1. A written program of requirements.
2. A copy of "Instructions to Architect and Engineers" to supplement the written program.
3. A set of space standards that the schools deem to be adequate for room sizes.
4. A soils report made by competent soils engineers, indicating the condition of the substratum.
5. A field-trip report made after visiting several schools with recently constructed facilities similar to the one being started.
6. A topographic map.

Each architect should be given all necessary information concerning the campus grid system and should be instructed to reference his building to it.

In addition, each architect should be officially notified who the school's representative (planning coordinator) will be and that everything pertaining to the planning of the project should channel through him.

# 5

# Plan Submissions

A discussion of this subject must be made in rather general terms because there are so many different methods used. If left to their own devices, most architects would probably use a method, or a variation of the methods, described in the American Institute of Architects *Handbook of Architectural Practice*, or as presented in *Architectural Practice*, by Clinton H. Cowgill, A.I.A., and Ben John Small, A.I.A. Many states and many schools have also developed their own requirements for plan submission by architects.

The way schools handle plan submissions probably depends on how strong a planning staff they have and whether they are largely autonomous so far as planning is concerned.

## Planning Procedure

With a knowledgeable planning staff of its own, a school can prepare its own Program of Requirements and make its own early estimate of cost. Such a school can, at the beginning of a project, supply the architect with information sufficient to enable him to spend more time on functional studies.

When a school does not have an office of its own capable of doing programming and making preliminary estimates of cost, it must rely on either the architect or a governing agency (perhaps a state office) to do that part of the work. Either alternative means that the school may suffer because it is relying on others to do what it might better do for itself. These practices aren't as common today as they were a few years ago, when a building was often planned and constructed with little or no input from personnel in Physical Plant or Buildings and Grounds. Sometimes even the future users of a building were not given adequate opportunities to participate in the planning processes. If such is still the practice at any school, it should be stopped, because modern school buildings are complex, highly specialized structures. And no architect, top school administrator, or member of a State Building Board possesses the knowledge necessary to tailor one to fit the functional requirements of its users. The future users should be utilized to the maximum to get their expert knowledge of functional requirements, and personnel in Physical Plant should be involved at every step because of the practical knowledge they have gained over the years by trying to efficiently operate and maintain buildings, many of which were designed and built without their active participation.

*How many times have you been in a meeting or among a group of Physical Plant people and heard such statements made as, "They built that building and never consulted with us—we could have told them that type of valve, that kind of floor, so much glass, etc., would not work." Then there is the ever present statement, "We sure would like to standardize on a lot of items which the Physical Plant has in stock. It would make operation a lot less expensive." In answer to this, there is no doubt in my mind that the Physical Plant Division can provide tremendous aid in planning and erection of new structures.*[1]

*When plans have been received by Physical Plant in sufficient time to make detailed reviews and such reviews are put off until the last minute making the effort at best a cursory one, those in Physical Plant have no one but themselves to blame for the mistakes that result. The excuse that the Physical Plant Department is too busy to make a review is not good enough in this case. The long-range impact that these plans have on maintenance costs is sufficient to mandate that time be made available to properly perform this important job. It is just possible that if the plant administrator does not take advantage of this opportunity, others may consider him responsible for the mistakes which result.*[2]

*There is nothing quite so disastrous to job morale as the lack of coordi-*

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[1] Ralph S. Collins, Director of Physical Plant, Clemson University, "The Physical Plant Division's Role in Planning and Construction at Universities and Colleges," Paper given at the Annual Meeting of the Southeastern Regional Association of Physical Plant Administrators of Universities and Colleges, Troy State College, 1965.

[2] Clarence P. Lefler, Director, Physical Plant Division, Ohio University, "Planning and Its Effect on Maintenance," Paper given at the Fifty-Ninth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, University of Cincinnati, 1972.

*nated plans and specifications, the errors in grades and dimensions that result in confused purchasing of materials and sub-contracts. Management must coordinate all phases of the project in order to keep the control from breaking down and creating costly delays in construction and thereby calling for an extension in the time schedule. Such a condition can be the beginning of extras. It is therefore very important, if possible, for the top management of Physical Plants to be given time to thoroughly study new plans and specifications of contemplated projects and together with the architects arrive at a meeting of the minds. Physical Plant administrators must learn to know the architect and his plans really well, as they are the main part of a team working to serve top management of the universities and colleges.*[3]

"Reviews and critiques of plans are generally made by the special project committee from a program and aesthetic viewpoint. Intensive, careful, reviews of all plans and specs are made by the Buildings and Grounds Department Office including the Director, Assistant Director, Chief Mechanical Engineer, and Master Electrician. Final review prior to construction is made by the Department of Buildings and Grounds."[4]

"Review [of plans and specifications] occurs at four times: (1) program requirements, (2) schematics, (3) design development drawings, and (4) working drawings and specifications. Review is by departmental contact, Director of Physical Plant, Director of Facilities Planning, and all Physical Plant Department heads and specialists."[5]

"The following review and critique plans and specifications for major projects: the occupying departments, for suitability and program compliance; the Plant Superintendent, for maintainability; the Facilities Program Coordinator, for above considerations and architectural review; and SUNY Central Administration, for all of the above. Each one reviews projects at schematic, preliminary, and working drawing stages."[6]

Assuming that a school does have a planning organization capable of doing good programming, studies, and cost estimating, the following method of plan submissions has proven highly satisfactory. Each architect is required to

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3. George W. McCreery, Lecturer at M.I.T., "Management-Coordination-Human Relations," Paper given at at the Forty-Seventh Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Massachusetts Institute of Technology, 1960.

4. Peter P. Welanetz, P.E., Director of Physical Plant, Williams College, Response to Author's Questionnaire on Planning and Construction, 1975.

5. Walter W. Wade, Director of Physical Plant, Purdue University, Response to Author's Questionnaire on Planning and Construction, 1975.

6. Frank A. Kopf, Director of Physical Plant, State University of New York at Albany, Response to Author's Questionnaire on Planning and Construction, 1975.

submit his work to the school, through the school's planning representative, for review and critiques at three principal stages: schematics, preliminaries, and working drawings.

**Schematics.** Each architect should submit his schematic drawings in accordance with the school's Program of Requirements. During the schematic phase, the architect should be encouraged to make *several studies* of the project in an effort to arrive at a functional solution satisfactory to himself and to school personnel. The drawings may be single lined. Developed elevations, sections, and perspectives might not be required. The idea is not for the architect to bring just one scheme, beautifully delineated in form and color that might help sell an inferior solution; rather, he should make a number of studies that will provide the school personnel with an opportunity to compare and choose. Probably not one of these first submissions will be approved, but the good features and the objectionable features of each will be noted, thus enabling the architect to present acceptable functional plans at the second or third review of his schematics with the school staff.

When a solution has been generally agreed upon, and before final approval of schematics is given by the owner, the architect should show, either on his drawings or on a separate typewritten sheet, a tabulation of space areas shown on his schematic plans as compared with those shown in the school's Program of Requirements. If there are considerable differences, these differences should be reconciled before approval is given to the schematic drawings. While elevations and sections may not be required, the architect should be encouraged to make a sufficient study of the arrangement of building masses to depict his general architectural concept of the project. It is also desirable that he submit a site plan showing the proposed orientation and siting of the building and how it relates to the campus master plan. When schematics have been developed to the school's satisfaction, the architect should submit copies of his schematic drawings. These are used for checking purposes by Physical Plant personnel, future users of the building, municipal plan checkers, state building board members, and the school administration. The number of plans required and who checks them will, of course, not be the same for all schools. If responsible people raise objections, the architect must meet with school officials until mutual agreements have been reached.

When the plans are acceptable, the architect should be given official approval of his schematics, and he should be authorized to proceed with the next phase, the preparation of preliminary drawings.

**Preliminary Drawings.** At this stage, the architect prepares floor plans (at a suitable scale and in considerable detail), elevations, cross sections, and any other drawings or sketches needed to show clearly the nature, size, and architectural concept of the project. At this phase his structural, mechanical, and electrical engineers should make studies. These studies should show the advantages and disadvantages of the various systems, and estimates of costs—initial and maintenance/operation—for each system. The engineers should also indicate if their proposals comply with the various E.P.A., safety, handicapped, and other municipal, state, and federal requirements. When applicable, some indication should also be given of the life expectancy, operating costs, ties to campus utilities system, and dependability of their proposals. At this stage also, the architect and his engineers should prepare outline specifications in which the general types of materials and equipment for each trade classification are shown in some detail. As a most important part of the outline specifications, an estimate of cost should be included. As this is the first time anyone has had sufficient information to make an intelligent estimate, it should be made carefully and realistically. The architect should be required to include on the main floor plan a tabulation of space areas shown on the preliminary drawings as compared with those previously shown on the approved schematics. As a further requirement, the architect should submit either a perspective (professionally done in color), a scale model, or both. Again, he should submit the required number of sets of plans and outline specifications for checking purposes. It is desirable that he poche one set of plans and mount them on stiff board for presentation purposes.

When preliminary plans and outline specifications have been reviewed and all comments received, the school representatives should meet with the architect and his engineers until all differences are resolved. When everything is in order, the architect should be given official approval in writing to proceed with working drawings. Neither the preparation of preliminary drawings by the architect nor their review by representatives of the school should be unduly rushed or taken lightly. This is a most important phase in plan development.

**Working Drawings.** After giving the architect approval to proceed with working drawings, school personnel should not be allowed to make major changes. All major decisions by the owner should be made during the schematic and preliminary phases. Changes during the working-drawing phase will not only be frustrating and costly to the architect and his engineers, but can result in plans that will cause problems during construction. And when those problems occur it is usually the owner who pays.

After the architect has received approval from the school on his preliminary plans, he may proceed with the working drawings. He must prepare these working drawings and specifications in harmony with the approved preliminaries. He also must design structural features in accordance with the local building code and follow the recommendations of the latest applicable building and life-safety codes.

The architect is instructed that the specifications are to be so written that each trade classification may be identified separately in the total bid and that competitive bidding may be had on all items. He should be required to confer with the school in instructions to bidders, form of proposal, performance and payment bond, form of contract payment, general conditions, and general scope of work. During this stage the architect is reminded to be especially careful in coordinating the structural, mechanical, and electrical designs with the architectural plans. Failure to do so will result in delays, costly change orders, and occasional hard feelings during construction.

*In recent years, the greatest coordination problems have arisen in the selection, identification, and specification of the controls of mechanical equipment where such is provided by the electrical system. This is aggravated by the tendency to make such controls automated to central systems. The Owner should assure himself that the electrical and mechanical engineers have made a complete and thorough investigation of all aspects of the control systems with special care being exercised to establish which of the subcontractors have the responsibility for furnishing and installing each particular item of equipment.*[7]

When all drawings and specifications are completed, the architect submits to the school the required number of contract document sets for checking. After a careful review by all concerned, marked check sets and written suggestions and recommendations are returned to the architect for any necessary revisions. In practice it is better to have the architect and his engineers visit the school and discuss all proposed changes or additions with the personnel involved. In this way everyone concerned is assured of a fair hearing. When working drawings and specifications have been approved, the time and place for opening the bids or tenders are determined. The required number of sets of drawings and specifications are bound, and the project is ready to be bid or negotiated.

Plan Reviews. Plan checking is so important that a "check sheet" should be used to insure that proper persons in Physical Plant and in other departments of the school are involved when a set of drawings is available for review. When plans alone or plans and specifications together are available for checking, one or more sets of documents should be placed in convenient locations and the "check sheet" sent to those who should check the documents. Comments from the several persons should be collected and edited by one person in Physical Plant or in the campus planning office. Comments from other members of the school staff should be combined with those of Physical Plant and given to the architect. After the architect and his engineers have had a chance to thoroughly review the comments, all those who are concerned should meet and reach final agreements. A sample "check sheet" is reproduced on page 154.

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[7] Fred L. Markham, F.A.I.A., of Markham and Markham, Architects and Engineers, Provo, Utah, Written Statement to Author, 1975.

**Alternate Planning Procedure**

Schools that do not have personnel in Physical Plant, or elsewhere in the school organization, capable of making feasibility studies and dependable estimates of cost will need to approach the planning processes for a new building in a manner slightly different than that described above. Often it is necessary to have a fairly accurate estimate of cost before a decision can be made to go ahead with the project. If school personnel can't provide the necessary information, it will probably be better to have an architect prepare schematic drawings *only*. In this instance, the schematics would include the development of plans and specifications in such detail that the architect can make a realistic estimate of cost. An agreement would be made with the architect that he might be given another contract to prepare preliminary plans and working documents if and when the project is approved. The architect would be paid the agreed-upon amount for the schematics whether the project went any further or not. If the project is approved, the architect's fee would be figured for the entire project less the amount already paid for the schematics, and a second contract would be drawn accordingly. To meet the schematic requirements under this plan requires more than the usual number of studies and plans. However, less is required in the preliminary phase if it is decided to go ahead with the project. When it is necessary to be sure of a number of things, but especially cost, before a final decision can be made to proceed with, modify, or scrap a project, this procedure has much to recommend it. On page 131 is an example of how an attachment to a regular architectural contract might be drawn to provide for schematic drawings *only*. (Note that the attachment does not obligate the school to work with the architect beyond schematics unless it chooses to do so.)

Should it be decided to go ahead with the project, the second contract, either with the architect who prepared the schematic study or with another architectural firm, would provide for preliminary plans and preparation of working drawings and contract documents.

**Preliminary (Design-Development) Drawing Requirements.** These requirements might be as follows:

Planning

1. A site plan acceptable to the owner.
2. Adequate design drawings, including floor plans, elevations, sections, structural, mechanical, and electrical plans sufficient to show construction systems and details.
3. Detailed specifications and cost estimate, including a statement explaining any deviation from the schematic cost estimate.
4. A comparison summary of area allocations between the building Program Requirements and preliminary drawings, including the total net assignable area, total gross area, and the resultant percentage design efficiency. This should include an explanation of any major deviations from area allocations in the schematic drawings.
5. A rendered perspective of the proposed project, suitable for framing. (A model may be required in addition to or in place of the perspective.)

Working-Drawing Requirements. Working drawings and specifications should be prepared in harmony with the approved schematics and preliminaries and should include everything normally provided for, plus any special requirements of the school.

Before plans and specifications are printed and bound, the architect should prepare on the cover sheet of the specifications and on the first sheet of the plans a place for those authorized to give approval. Someone at the school should supply the architect with the names and titles of those persons who are to sign the contract documents. As can be seen from "Information on Planning" as reported by forty-two schools on pages 311-16, there is a great variation among schools as to who does have final authority for approving plans and specifications.

Normally, architectural contracts call for the architect to furnish a certain number of bound copies of plans and specifications. Most often this number is short of the number actually required. When this happens, it is the school's responsibility to pay the architect his actual cost for any plans and bound specifications beyond those specified in his contract. Plans and specifications are usually numbered consecutively in order to keep a record of them, and during the bidding period they may be issued to bidders from the office of the architect and from a designated office at the school. In addition, plans and specifications should be placed in all the plan rooms in the state. A decision will need to be made as to how many sets a general contractor will be allowed (three sets seems to be adequate) and whether plans and specifications will be issued to subcontractors and major material suppliers. A deposit should be required before a set of documents is issued, and the amount required should depend on the cost of printing and assembling the documents. After the bid opening, the deposit is refunded to anyone returning his documents in good condition. A deposit is not generally required of contractors who are members of "Associated General Contractors."

In some areas, with the owner's consent, the architect may furnish contractors with sets beyond those issued by the owner. Such sets are not furnished at the owner's expense.

**Architectural Contract for Schematics Only.** The use of this type of contract is explained on page 129. The following contract could be written as a separate document, or it could be an attachment to an architectural contract:

Annexed to Architect's Agreement, dated ________ between ________ College and ________, Architects.

The architect is authorized under the terms of this contract to prepare schematic drawings *only*. These plans shall consist of the following:

1. Acceptable single-line floor plans in accordance with the Building Program Requirements. Several studies should be made for consideration and approval by the owner. When floor plans are approved by the owner, then the architect may proceed with the following:

2. A site plan showing the general shape of the proposed building and location of adjacent buildings, streets, sidewalks, parking lots, etc.

3. Elevations and sections sufficient to indicate appearance and method of construction. Several elevation studies should be made for consideration and approval by the owner.

4. One set of poched drawings for presentation purposes, including site plan, floor plans, and elevations and sections. These should be in color and mounted on illustration board.

5. Outline specifications, including a carefully prepared estimate of construction cost.

6. A comparison summary of area allocations in the Building Program Requirements with those in the Schematic Drawings, including the total net assignable area, total gross area and the resultant percentage design efficiency. This should include an explanation of any major deviations from the Building Requirements area allocations.

The above work is to be accomplished within 45 days from the date of this agreement. When the above has been done to the owner's satisfaction, the architect shall be paid $10,000. Payment of this $10,000 will terminate *this* agreement.

Should it be decided by the owner to construct this project, or any part of it, an architect's agreement *may* be drawn with ________ architect, to prepare the necessary preliminary and working drawings and specifications, the necessary contract documents, and to provide other services as will be required by

> the owner during construction of the project. For whatever such work authorized, the architect will be paid a fee of 5½ percent, the final architect's fee to be calculated after the project is completed and the exact contract price is determined. The contract price will be determined by taking the original contract price minus all credits to the contract during construction, plus all extras to the contract during construction, except no architect's fee will be paid on any amount greater than 110 percent of the architect's estimate of construction cost made by him at the time of submission of schematic drawings.
>
> If an agreement is entered into with the architect to prepare preliminary and working drawings and other necessary bidding documents, the owner will pay to the architect 25 percent of the architect's fee based on the estimated construction cost, less $10,000, when preliminary drawings have been accepted by the owner. This fee will be paid in equal monthly payments during the period preliminary drawings are being prepared.
>
> During the working drawings stage, payment will be 50 percent of the architect's fee based on the estimated construction cost payable in equal monthly installments.
>
> During the construction stage payment will be 25 percent of the architect's fee based on the estimated construction cost to be paid on a monthly inspection basis, to be determined by the completion schedule of the contractor. Final settlement will be made in the last payment when total construction cost is known.

**Form of Proposal.** The specifications for a project should contain among many other things a "Form of Proposal." This is the form that the contractor will use in submitting his bid or tender. It is an important document and should be prepared with care. Because of its importance, it would be well to have it reviewed by the school's legal counsel before using it for the first time. The following is the "Form of Proposal" used at Brigham Young University. Note especially the paragraph on "Substitute Materials," and the sheet to list the subcontractors the general contractor uses in compiling his base bid.

### Form of Proposal

**Name of Project** ____________________

**Project Number** ____________________

**Name of Contractor** ____________________

**Date of Proposal** ____________________

The undersigned, hereinafter referred to as the bidder, certifies that the following facts and/or circumstances have occurred or exist relating to the proposed work for ____________________

____________________

prepared by ____________________ .

1. That bidder has received the contract documents for the above entitled project as listed in the table of contents.

2. That bidder is familiar with such documents, has examined the site of the proposed work, including availability of access, utilities, and other similar items relating to performance of the work, and is thoroughly familiar with all general and local conditions which could in any way affect this work.

3. That no verbal agreements or representations with or by any officer, agent, or employee of the owner exist or have been made to the bidder and the bidder in submitting this proposal is in no way relying thereon.

4. That if this proposal is accepted, bidder will enter into a contract with the owner in substantially the form contained in the contract documents, and will provide the bonds, insurance coverage, and all other items required by the contract documents.

5. The term "base bid" shall be understood to include all work contained in the contract documents, excluding any substitutes. The contract will be awarded on the basis of base bid only, without references to substitutes.

Bidder hereby proposes to furnish all materials, labor, equipment, plant, tools, transportation, services, licenses, and permits necessary for the completion of the work set forth in the contract documents for the sum of:

Base bid ________________________________________

____________________________________ ($____________)

As Further Conditions of this Proposal

1. The bidder agrees to complete the work on or before____________.

2. The bidder is aware of, and agrees to, the provisions for liquidated damages set forth in section 19 of the Instructions to Bidders.

3. The bidder acknowledges receipt of addenda no(s).________ to ________ inclusive and has considered the same in preparation of this proposal.

4. The bidder agrees to furnish the performance and labor and material payment bonds required in section 14 of the Instructions to Bidders.

5. The bidders contractor's license number is________. Such license is issued by the state of ________.

### Unit Prices

The following unit prices may be used in computing the value of the changes, additions, or deductions in adjusting the contract sum during the period of construction and shall include all the proportionate costs such as taxes, insurance, and supervision. Deductions will be based on the net price quoted. Additions will be based on the net price quoted, plus 5 percent to cover all overhead and 10 percent for profit.

Note. Architects or engineers shall add or delete appropriate items.

1. Furnish and install earth fill exterior, 90% compaction, per cu. yd. in place $__________
2. Furnish and install gravel fill, per cu. yd. in place $__________
3. Concrete (no forms, no steel), per cu. yd. in place $__________
    a. 3,000 psi concrete $__________
    b. 3,500 psi concrete $__________
    c. 4,000 psi concrete $__________
4. Concrete forms, per sq. ft. (including stripping) $__________
5. Reinforcing steel in place, per lb. $__________
6. Reinforced concrete sidewalk, per sq. ft. (with base and reinforcing complete) $__________

7. Concrete curb and gutter, per lin. ft. complete (including forms scoring and expansion joints) $__________
8. Asphalt paving, per sq. ft. (with preparation of subgrade and base courses and surface courses as specified) $__________

### Proposed Substitute Materials

The total sum of the bidder's proposal shall include the furnishing and installing of all materials, equipment, and labor as called for in the contract documents as a base bid.

Hereinafter give the total amount to be added or deducted for a complete installation if equipment or materials other than those specified and those approved by addendum are submitted for the owner's consideration. All

**materials and equipment proposed for substitution shall be listed below and must meet the requirements of the contract documents. During the time of consideration of the proposals, complete information shall be submitted immediately to the architect and to the owner's representative. The contractor is referred to section 15 of the Instructions to Bidders, "Substitution," for requirements relative to proposed substitutions.**

| **Proposed Substitute** | **Manufacturer and Catalog Numbers** | **$ Add** | **$ Deduct** |
|---|---|---|---|
| | | | |

**(Owner's name)**
**(Project name)**
**Revised December 1, 1972**

**Church Educational System**
**Form of Proposal**
**P/3**

## Bidder's List of Subcontract Bids Used in Proposal

**(List of Subcontractors)**

**Project Name** ____________________

**Project No.** ____________________

**Owner's Name** ____________________

**(Architect to fill in appropriate subcontract classifications below for which information is desired.)**

| **Division** | **Subcontract Classifications** | **Subcontractor Used** | **Amount** |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

**(Owner's name)**
**(Project name)**
**Revised December 1, 1972**

**Church Educational System**
**Form of Proposal**
**P/4**

**Type of Bidder's Organization**

____________________
**Official Name of Organization**

____________________
**Corporation, Copartnership, Individual, or Other**

____________________
**Address**

Name of Individual Members of Firm

________________________________________

________________________________________

________________________________________

Name of President of Corporation

________________________________________

Name of Secretary of Corporation

________________________________________

Corporation is organized under the laws of the State of

________________________________________

Signature Must Be Affixed Here

( )
)Seal(
( )

Signature ____________________

Title or Office ____________________

Legal Address ____________________

____________________________

____________________________

(Owner's name)
(Project name)
Revised December 1, 1972

Church Educational System
Form of Proposal
P/5

**Substitutions ("Or Equal" Clause).** An architect will often specify certain products and then tack on, "or equal." This is when the "soup hits the fan." There isn't a material supplier or equipment salesman whose product wasn't specified that won't insist that his product is as good or better than any like product on the market. Representatives of these firms will generally start with the architect or engineer who will most likely refer them to the school's representative. The school's representative will then be subjected to high-powered sales pitches to have a product he may never have heard of specified as acceptable. The only information immediately available is what a company and its representative say about their own product. There is always the concern that they might be slightly prejudiced and that their product will not be all that is claimed for it. On the other hand, just because it is an unknown product does not mean that it isn't a superior product. There is always the possibility that it is as good as or better than the products specified. So the owner's representative and the architect/engineer have the choice of rejecting an item that might be better than the ones specified or accepting an item that might turn out to be the granddaddy of all lemons. What is the answer? There probably isn't a completely satisfactory answer, but if there is sufficient time, products can be carefully checked and unbiased reports obtained on their merits or demerits. But there is seldom time to do a thorough research job on a questionable product just prior to bid opening. About the best that can be done, in fairness to all concerned, is to allow companies with such products to make a substitute proposal. Substitute proposals would not be considered by the contractor in putting his bid or tender together. But after the low bidder is determined, the architect/engineer, the school's representative, and the contractor can take the time necessary to investigate substitute proposals. If it is then determined that a product not originally specified is acceptable and at a lower price, it can be made a part of the project by a change order. Occasionally a product turns out to be so much more desirable than the ones specified that it has been accepted at a higher price than the product used by the contractor.

The "or equal" clause should probably be used as little as possible. It is better to specify products known to be acceptable and to include a statement in the "Instructions to Bidders" about substitutes. The following is an example of such a statement:

> **Prior Approvals and Substitutions**
>
> 1. In order to establish a standard, wherever possible three or more acceptable brands of equipment, manufactured articles, or methods of construction have been identified in the contract documents. In such cases, it is not intended to close the contract documents against other brands, articles, or methods which may warrant consideration. Competition is encouraged because it is in the owner's interest.
>
> 2. *Prior Approvals.* Requests for prior approval of items not explicitly specified may be made to the architect up to and including the seventh day preceding the date on which bids are to be submitted.
>
> 3. Fully detailed technical data, references, and information shall be furnished simultaneously with the requests for prior approval items.
>
> 4. Such requests will be given due consideration by the architect or engineer (strike one) and owner and, in the event of acceptance, will be included in an addendum.
>
> 5. The contractor's "base bid" shall include the furnishing of only those items which are *explicitly specified* or which have received *prior approval* by addendum.
>
> 6. *Substitutions.* In addition to the "base bid," any equipment or material supplier and any contractor or subcontractor may, at his option, submit a sub-

> stitute proposal for any item specified which he feels warrants consideration by the owner. The proposed substitution is to be listed where indicated on the form of proposal.
>
> 7. Any proposed substitute submitted by a contractor shall include the amount that the said substitute would add to or deduct from the "base bid."
>
> 8. The owner may accept or reject any substitute proposed; however, in determining the low bidder, only the "base bid" will be considered. Substitutions will not be considered in determining the low bidder or award of the contract.
>
> 9. On demand of the owner, the contractor, at his own expense, shall furnish information or data concerning the item offered by him as a substitute. If the owner shall so require, the contractor, at his own expense, shall have said item tested under the direction of the owner as to its physical and performance characteristics, by an approved testing laboratory.
>
> The following is a statement pertaining to the "or equal" clause contained in a book entitled *Instructions to Architects and Engineers*, prepared by Brigham Young University for use by all architects and engineers doing work for the LDS Church Educational System:
>
> It is the policy of the Church Schools to have *open* specifications. The title of Church Schools method of specifications is called "Base Bid with the Contractor's Multiple Choice." This means that wherever possible, the contractor is given three or more materials or methods upon which to bid. Any of these would be acceptable to the college. However, the contractor *must* base his bid on one of the specified materials or methods. The specified material or method must be clearly stated (including all required technical data, descriptions, manufacturers' names, catalog numbers, etc.), so that a contractor will have a complete understanding as to what he is required to do. The "or equal" phrase *shall not* be used, as this is a constant source of contention.

## Construction Schedules

The school will undoubtedly specify the time of completion of a project, and when the contractor signs the construction contract, he agrees to complete the project by the designated time. However, with the present labor and materials situation, it is easy to get behind schedule without realizing it unless a "construction schedule" is established at the beginning of the project and kept current throughout the life of the project.

A school is obviously interested in knowing if a project is on schedule because class schedules will often be arranged well in advance of the completion of a classroom building on the assumption that the project will be finished on schedule. If it is not to be ready for occupancy on schedule, the school authorities need to know as soon as possible so that other arrangements can be made. Space in a residence hall is often contracted for well in advance of completion. It is important that the housing people know at an early date if the building cannot be completed on schedule.

A school preparing to bid a sizable project should require, by means of a paragraph in the "Instructions to Bidders," that the successful bidder furnish to the owner's representative or the architect a progress schedule delineating how he intends to construct the project. He should be required to submit a realistic method of analyzing and scheduling each component part of the work as it pertains to the whole. It should be so organized as to show all trades or crafts, when they are to start, and when they are to finish their work. It should be stated that the schedule must be received and approved by the architect or the owner's representative prior to the submission of the contractor's first monthly progress esimate.

The schedule should be reviewed with the contractor or his construction superintendent at least monthly on large projects, and more frequently on smaller projects. It should be revised as often as necessary to insure that it actually reflects the current progress of the project. If it is obvious, as the work progresses, that the project is falling behind schedule, every effort should be made by all concerned to speed up and get the project back on schedule. If it is determined, after doing all that is possible or practical, that the project will not be finished on schedule, the concerned school officials should be notified and a revised completion schedule should be given to them so that they will be able to revise their schedules accordingly.

There are several types of construction schedules that might be used. Perhaps the simplest one is a "bar-graph schedule." It would consist of a drawing with the years and months shown along the top of the sheet and the major components of construction shown down the left side of the drawing. Bars would then be drawn horizontally to show what day of the month and year each major subdivision of the project should start and on what date it should be finished. The last date should show completion of the project, and this date should be from two weeks to thirty days before the completion date specified in the construction contract. This is to allow time for final inspections and for the contractor to work through the "punch lists," so that the project will really be finished by the specified completion date.

A bar-graph schedule is not very reliable, especially on a project of any size. It simply does not show enough detail or the interaction of the various trades. It would be sufficient on smaller projects.

Another method of construction scheduling that has proven effective, especially on large and rather complicated construction projects, is "critical-path scheduling."

*Critical-path scheduling is an effective management tool, when properly designed and properly applied. On large construction projects, it is most effective in that it enables the owner to see that his project is proceeding according to plan. Of course, no project is going to proceed exactly as planned* *from start to finish simply because a network is designed at the beginning of a project showing the various components of the project and the values assigned to those components. Changes will have to be made frequently; contingency allowances must be included, and re-evaluations made regularly.*

*The basic premises of critical-path scheduling are:*

*1. A preliminary conference is held by the scheduler with all persons responsible for the activities to be scheduled. Based upon the information he elicits during the conference (or conferences), values are assigned to each activity, for example, time values. The time values can be precise, an exact start/finish date, or within a given range, an early-start/late-start date, and an early-finish/late-finish date.*

*2. A network, or graphic representation of all activities is drawn, showing the dates for each activity.*

*3. The project is carefully monitored at regular, pre-determined intervals to see that goals that have been set are met and to make projections to foresee upcoming problems.*

*4. The network is updated regularly and, in many cases, will be completely redesigned one or more times.*

*5. Regular reports of the project progress are made by the scheduler as a part of monitoring the project so that current information on the status of all of the activities of the project is constantly available. These reports can be prepared by either manual or computer methods, depending upon the requirements of the project. If multiple resources are to be controlled, the computer programming method is by far the most economical and efficient.*

*The single most important factor in a good critical-path schedule is whether it will actually be used as it is intended. The things critical-path scheduling can do have become so well established that it is often required on construction projects. It is occasionally criticized because, while its principles are readily apparent, the practical application of the principles requires understanding, skills, and experience that are not easily acquired. However, in spite of this, it is such a productive management tool that it should be given consideration on large construction projects.*[8]

*The most complete and detailed form of project scheduling is the 'Critical Path' method. In this procedure, the contractor anticipates delivery of materials and the inclusion of sub-contractor work prior to the time that they are needed. Their anticipated delivery is also related to other work which is to be performed in close connection therewith. The contractor's super-*

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[8] Don S. Domgaard, Domgaard Associates, Management Consulting and Information Systems, Salt Lake City, Utah, Letter to Author, 28 March 1975.

*intendent, the sub-contractors, and the project supervisor are thus alerted to all that will be needed well in advance of the time when each item is required for inclusion into the structure. The Physical Plant Director should become advised of this method of scheduling so that he understands the procedure being followed by a contractor.* [9]

The cost of critical-path scheduling can vary from perhaps 0.1 percent to 2.5 percent of the contract cost of a project. The cost will depend on the complexity of the project, how much control the scheduler is to provide, and the type of service to be supplied. If it is highly important that a large project be finished on time, and if the contractor will cooperate, critical-path scheduling is worth considering. If the use of critical-path scheduling is desired, it should be so stated in the "Instructions to Bidders."

The purpose of a construction schedule can be briefly summarized as follows:

1. To keep the school and the contractor current on the progress of the project.
2. To make it possible for adjustments to be made quickly and realistically as a result of strikes, slow delivery of materials and equipment, damaged items, program changes, unprecedented bad weather and other "acts of God," and so on.
3. To better coordinate labor and workmanship with arrivals on the job site of materials and equipment.
4. To provide for better coordination of work between the trades.
5. To help coordinate the interrelationships of the many and varied activities.

If such items as the above are not carefully attended to during the progress of a project, the project is bound to suffer. Generally contractors are over-optimistic about their ability to finish a project within the time specified in their contract. They often will insist that they are going to complete a project by a certain date and then overrun that date by many months. Construction scheduling does not guarantee that a project will be finished according to the contract agreement, but it can certainly help. And knowing, not guessing, how the project is progressing will prevent rude awakenings and panic-button pushing toward the completion date, when it is finally conceded that the project is only 90 percent complete and that it is too late to do anything about it.

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9. Markham, Written Statement to Author, 1975.

### Perspective or Model

Often plans or architectural proposals must be presented to persons who are not sufficiently experienced in reading plans to understand them. For these people it is most helpful to have either a perspective or a scale model to show. Persons who cannot understand a two-dimensional plan will quickly visualize the appearance and scope of a project if it is presented in three-dimensional form. Elevations and sections help the inexperienced, but they should be supplemented by either a perspective or a model or both. They are not only helpful to those unaccustomed to reading plans, but they are a valuable planning aid to the architect and to the professional people he works with. These planning aids are so important that no major building project should be allowed to progress into the working-drawing stage without one or the other.

There are advantages and disadvantages to both the rendered perspective and the scale model. The chief advantage of a rendered perspective is that it shows a project in its best light. It is often a work of art and is so pleasing in appearance that it would look good on almost anyone's wall. Occasionally the person doing the perspective will do such an artistic job that the picture will outshine the finished product. However, besides doing a good selling job, a perspective is also helpful to both architect and owner in that both can determine if certain proportions and details are acceptable. There are firms that specialize in doing perspectives, and their work is usually superior to perspectives done by project architects. Many architects realize this and send their plans to one of these firms for execution. It is helpful if a few photographs of the site and adjoining landscape can go along with the plans. This will enable the artist doing the perspective to present the building in an indigenous landscape setting. It is never quite convincing when a project that will be built with a snow-covered mountain in the background is rendered with a central states setting, or vice versa. It is certainly recommended that the architect be required to submit a rendered perspective suitable for framing as a part of his preliminary drawings on any major building project.

"The scale model is to be considered a tool—a tool for planning in the same sense as a slide rule or a data book; a tool for presentation in a same class as a fine brochure. Intelligently used, scale models are a constructive and economic approach to a difficult set of problems."[10]

Models are not too difficult to make. Any good architectural office can produce scale models of their projects. Models can be very simply made or they can be quite elaborate. Many are simply constructed on a flat base. The

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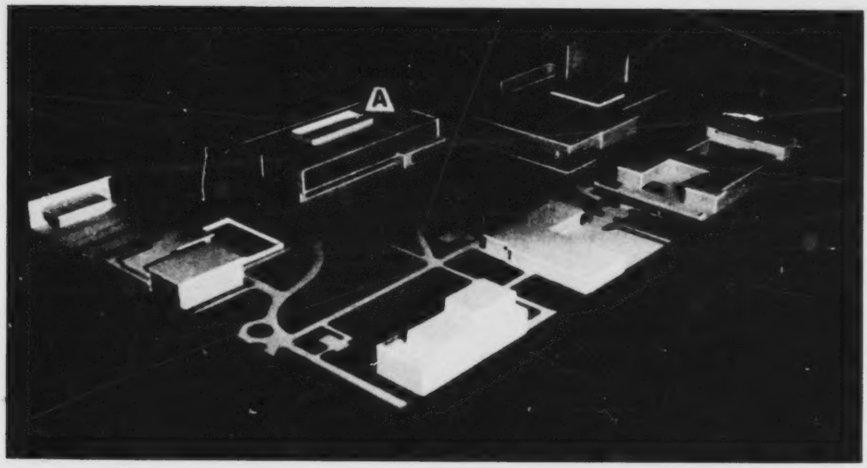
[10] Leonard N. Abrams, Partner, Panoramic Studios, Philadelphia. "Planning and Presenting New Schools with Scale Models," *American School and University* 25 (1953-54): 139-40.



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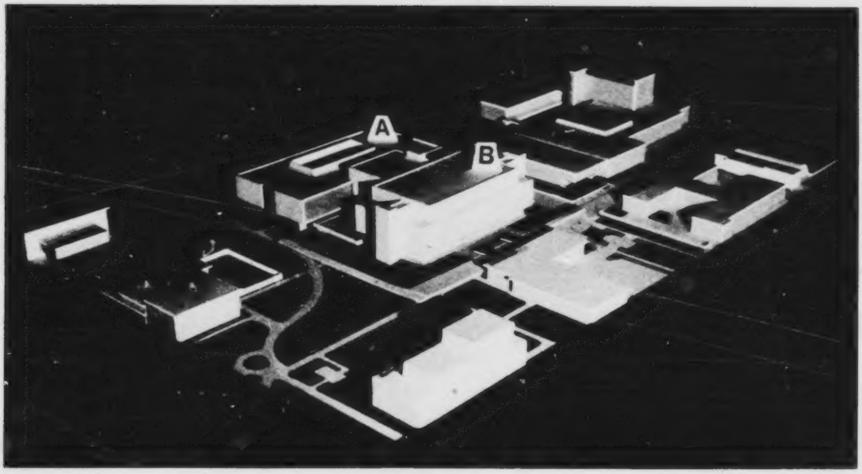


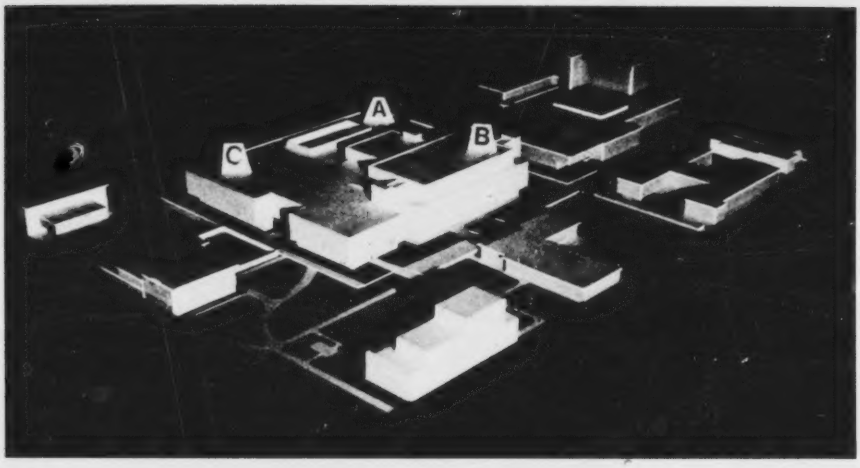
2

The problem was to put a large addition (210,000 gross square feet) onto an existing building and also to make it possible to add a second addition in the future.

Photo 1 shows the existing building in relation to other existing buildings and the open space available for the proposed additions.

Photo 2 shows an arrangement for the first proposed additions.

Photo 3 shows how a second addition could be added.



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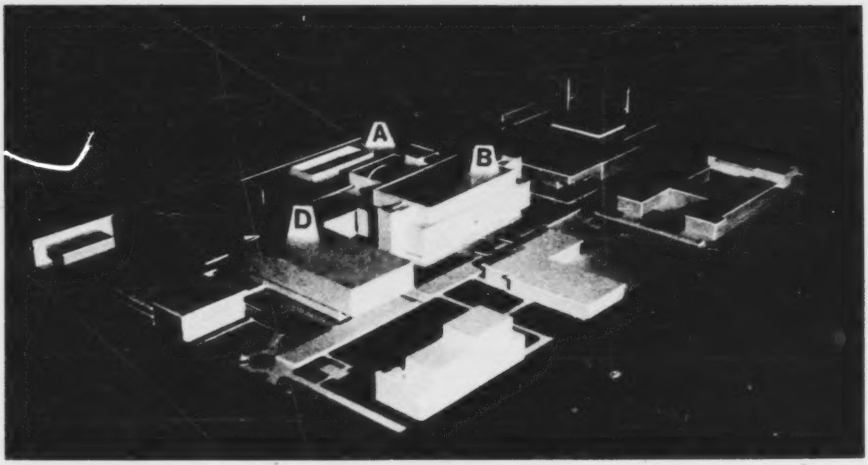

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Photo 4 shows another shape and arrangement for a possible second addition. Several additional models for the second addition were made. The model was so constructed that each addition could be lifted off and a different study dropped into place.

These models not only contributed much to the planning of the project, but were instrumental in obtaining approval to proceed with the project.

more elaborate ones will be built up to show the proposed ground form. Models of buildings are especially effective if they are made so that they can be partially taken apart to show interior arrangement. There are firms who make a specialty of constructing models. If a really elaborate one is needed for a large project or for an entire campus, the university architect might suggest that such a firm or firms be employed. In such a case, the university architect should be able to propose a firm or firms for consideration.

The scale model is being used more and more often, and for good reasons. About the only disadvantage to a good model is that it can't be hung on the wall of some campus VIP. Also, in time the model will fall apart unless maintenance work is done on it. Storage of a number of models can also become a problem.

The following list of advantages that a school and its architects can gain from a scale model was prepared for the author by Robert A. Fowler, A.I.A., Associated Architects, Salt Lake City, Utah:

1. *The finished product can be seen from every angle.*
2. *A site model will show the relationship of new buildings and existing buildings.*
3. *A landscaped site model will show landscaping, exterior lighting, paving, and other site-development features.*
4. *Materials and color must be taken into consideration at an early date (before a true model can be constructed).*
5. *Sequenced construction steps can be made removable.*
6. *Future additions can also be proposed without the expense of elaborate design drawings.*
7. *The building, if removable, can be moved about the site to determine the best possible location with respect to other buildings, site slope, and the like.*
8. *The model speaks for itself. It usually requires no other explanation, and it is immediately understood.*
9. *A model has great public-relations potential.*
10. *A model can be photographed by itself from various angles and with various lighting arrangements. Also, it can be photographed with sponsors, owners, etc., for press releases.*
11. *The cost of a model is often about equal to the cost of a good color rendering. The model shows all views, whereas the rendering shows only one.*

*There are advantages to the architect as well as to the owner, and many architects are preparing models to help him in design whether a model is required by the owner or not. The following are some of the benefits an architect might realize from a model:*

This may look like an aerial photograph, but it is a model of the Purdue University campus and surrounding area.

*1. Study models (often without color) are excellent design tools. If a site model (small scale) is made, it is easy to study alternate proposals and schemes without the expense of drawings and reproductions.*

*2. The model itself often suggests solutions—visual, spatial, circulatory, structural, material, etc.*

*3. The mechanics of the model's own materials (limitation of span, stability, shrinkage, etc.) tend to simplify the final proposals.*

*4. The model generates enthusiasm among the consulting members of the design team. It points up problems early.*

*5. The well-constructed model assures that the final building will have proper scale with respect to site and surroundings.*

*6. A take-apart model can show interior spaces as well as exterior elevations.*

*7. An architect is more confident of what he is proposing if he can see the actual thing in three-dimensional form. He has the chance to study the spaces and manipulate the forms until he is totally satisfied with all the basic architectural relationships.*[11]

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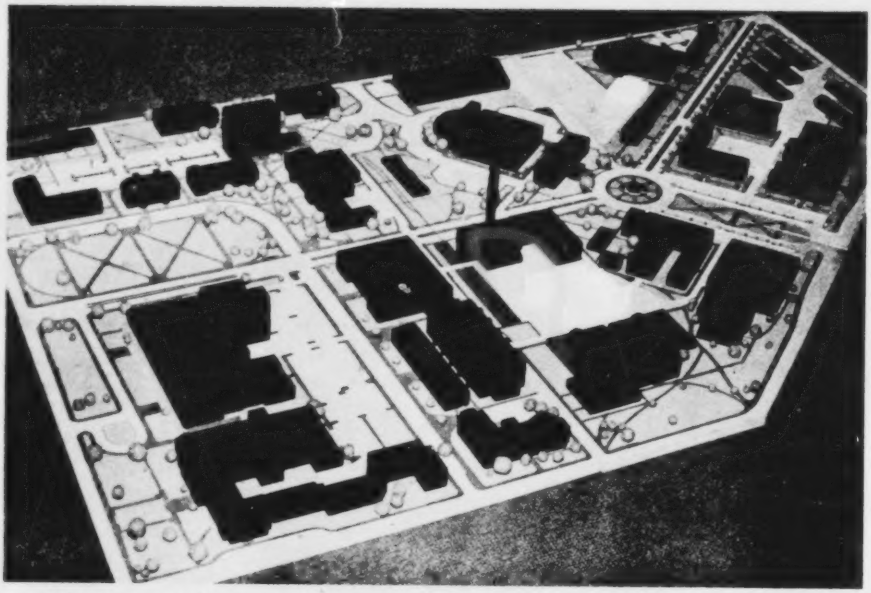
[11] Robert A. Fowler, A.I.A., Associated Architects, Salt Lake City, Utah, Written Statement to Author, 1975.



A working model of a portion of the Purdue University campus. It is in sections and can be stored in a cabinet 3 feet by 4 feet when not in use. The model shows older existing buildings, newly constructed buildings, a building under construction, and buildings in the planning stages. A good example of the practical use of a model.

A model need not be limited to a single building or to a single complex of buildings. It is also an excellent tool for studying the site development of an entire campus. It is recommended that any school being newly developed not only have a site or master plan prepared, but that it also have a scale model of the plan constructed. The model will point up many good and bad features not easily recognized in the plan itself. Bad features discovered from the model can be corrected on the plan. This method of careful planning will result in a more functional campus, possibly even a more attractive one, at no greater expense and perhaps far less.

*I think the solution to the master plan problem is not so much your master plan as a master model. The model has several advantages. A model does have a great deal more flexibility than the master plan itself. Architects like to make a very pretty drawing which is spoiled when you make changes on it. You can easily relocate your buildings on your model at not too great an expense. Since a master model is a three-dimensional thing, you can get into transportation circulation.* [12]

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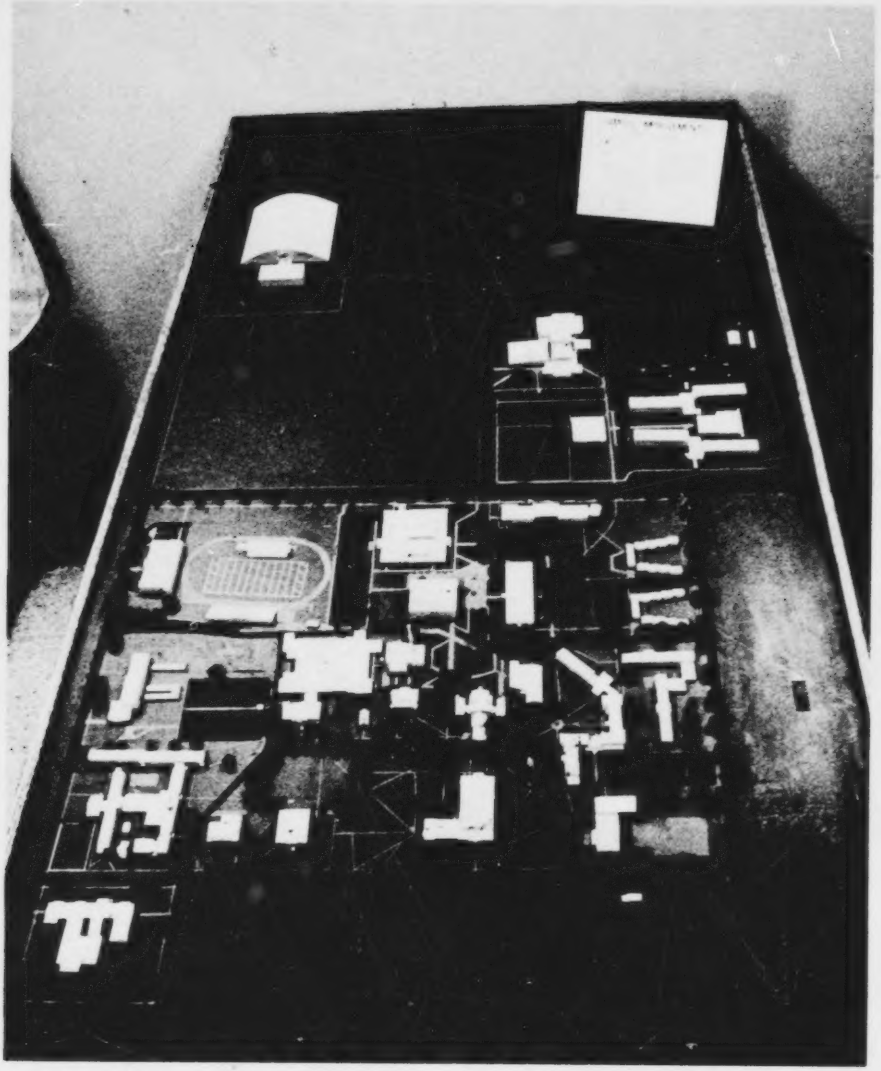
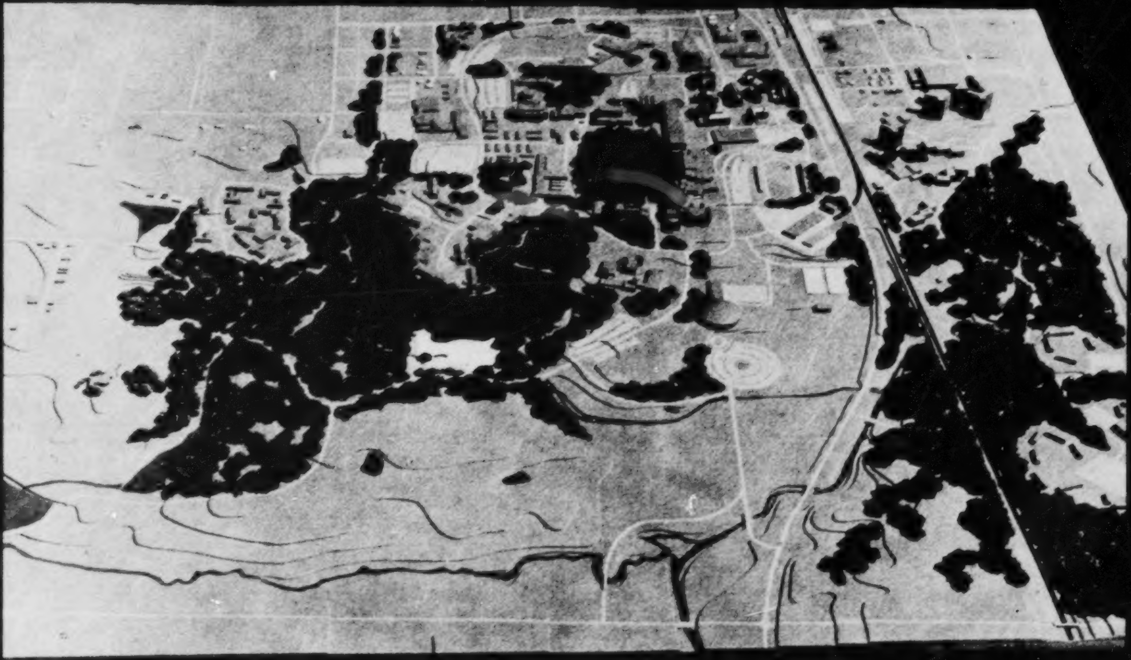
[12] Joe E. Smay, University Architect, University of Oklahoma, Panel Discussion, Thirty-Fourth Annual Meeting, Association of Superintendents of Buildings and Grounds of Universities and Colleges, Ohio State University, 1947.

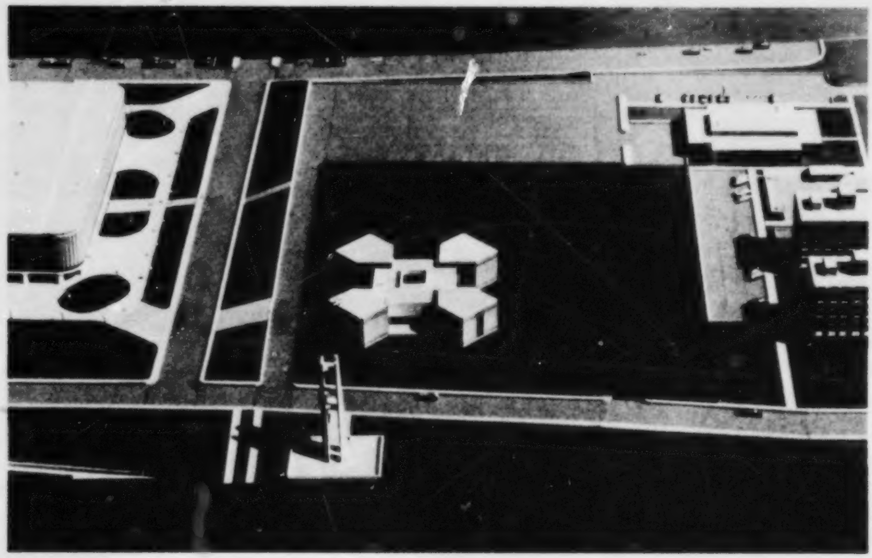


Model of the University of South Dakota. (The plaque in the upper right-hand corner contains information on remodeling, deferred maintenance, and capital improvement projects for the fiscal year 1976.)



Many schools have prepared models of their campuses. Master models and master plans are of great value in helping develop an orderly and functional campus. This is the campus model of Southern Illinois University at Carbondale.

Both the perspective and the model are valuable planning devices, and both should be used on sizable projects, because they complement each other remarkably well.



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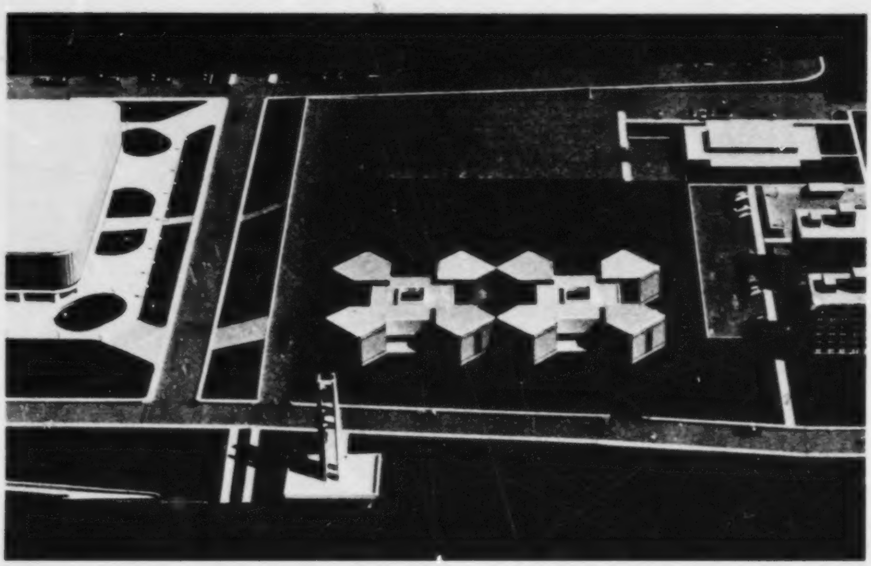
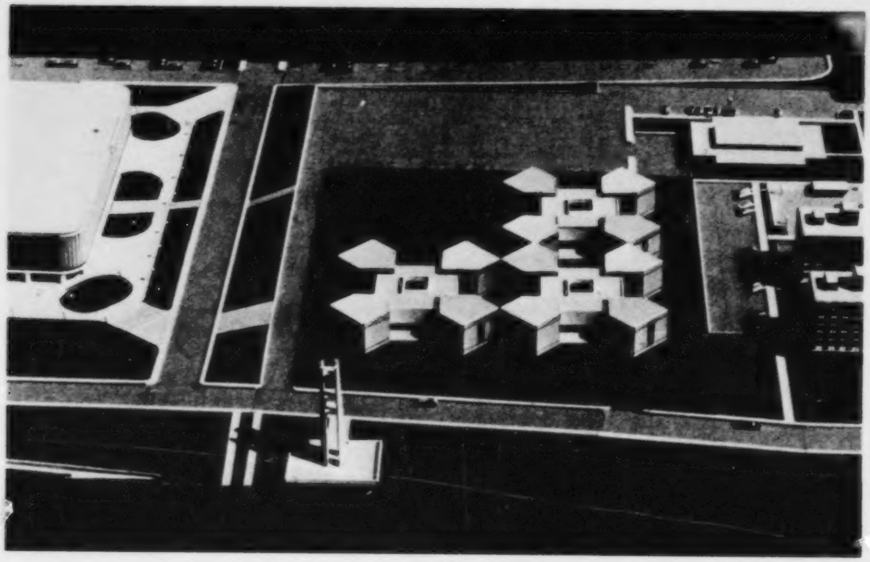


A study prepared to show how a museum could grow from an initial building (photo 1) to an eventual complex of four interrelated buildings (photo 4). Note the final arrangement of the four units. (Photos courtesy of Robert A. Fowler, A.I.A.)



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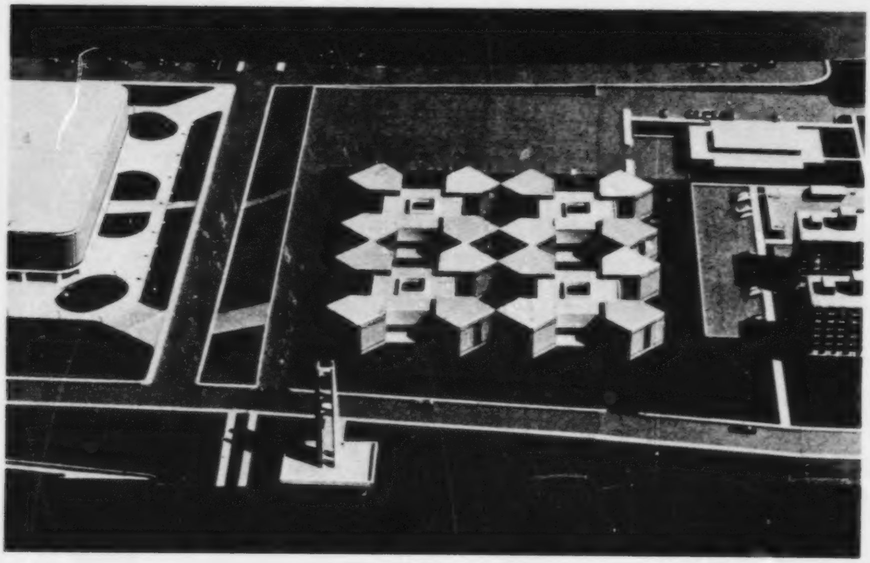

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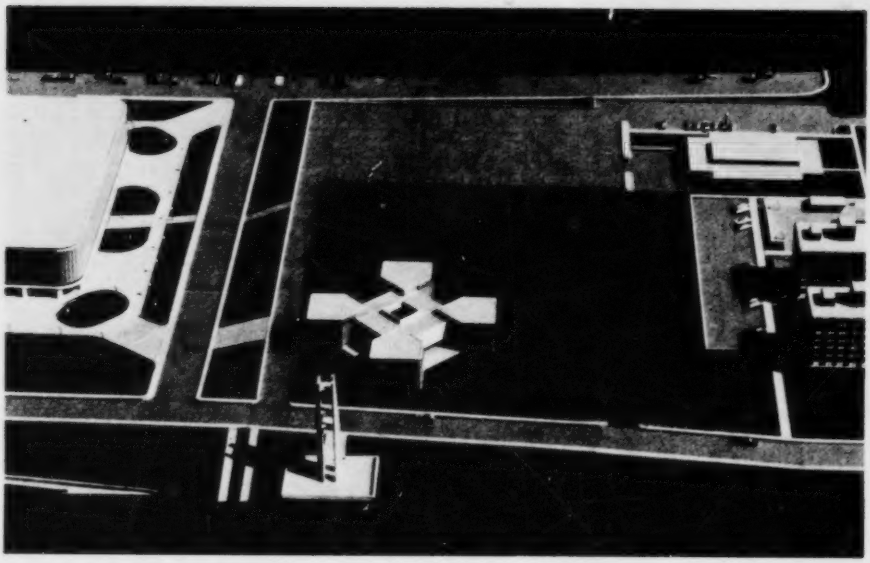
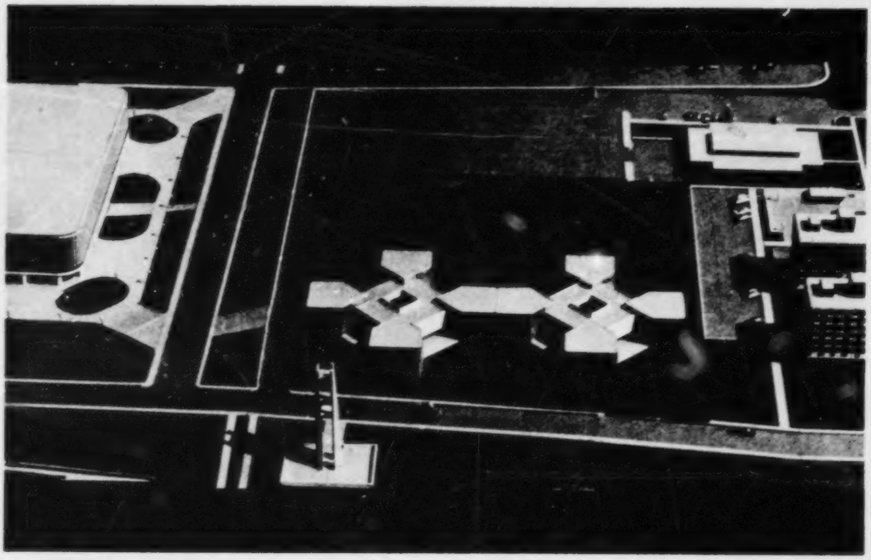
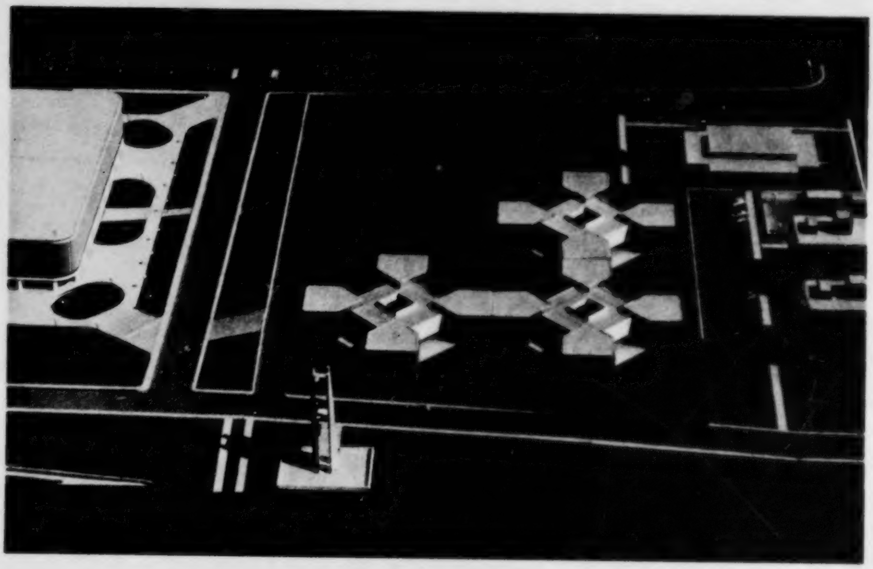
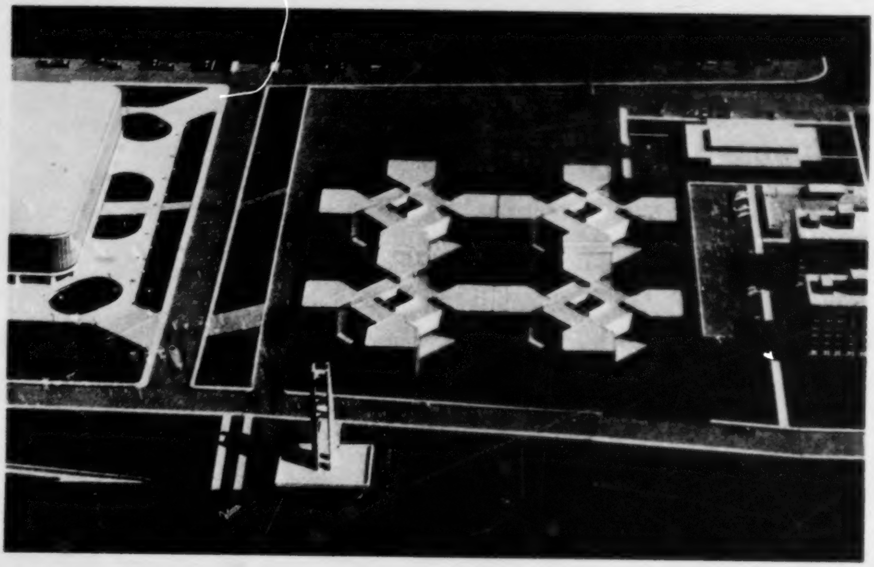




These are the same units as shown on pages 150 and 151 but sited differently. Note the difference in the final arrangement of the four units.





**Check Sheet for Plan Reviews.** The desirability of using a check sheet such as this is described on pages 128-29.

### Check Sheet

(Brigham Young University)

The following people will review the attached material identified below and submit a written report of any criticism or discrepancy and/or recommendation to ____________ by ____________ a.m./p.m. ____________ 19___.

Project: ____________________ Project No.: ____________________

Special Instructions: ________________________________________

| Name | Title | Check | Date-Time Received | Date-Time Completed | Initials |
|---|---|---|---|---|---|
| | Director | | | | |
| | Ass't. Director | | | | |
| | Constr. Eng'r. | | | | |
| | Ass't. Constr. Eng'r. | | | | |
| | Chief Bldg. Insp. | | | | |
| | Civil Eng'r. | | | | |
| | Grounds Supv. | | | | |
| | Mech. Supv. | | | | |
| | Carp. Supv. | | | | |
| | Custodial Supv. | | | | |
| | Paint Shop Supv. | | | | |
| | Elec. Shop Supv. | | | | |
| | Heat. Plant Eng'r. | | | | |

____________________ Director, Physical Plant

Date: ____________________

## Summary

When a school does not have an office of its own capable of doing programming and making preliminary estimates of cost, it must depend on either the architect or a governing agency, perhaps a state office, to do that work. In either case, the school may suffer because it is relying on others to do what it might better do for itself.

All plans at all stages should be carefully reviewed by school staff, especially the staff in the Department of Physical Plant.

When it is necessary to have a fairly accurate estimate of cost before a decision can be made to proceed with a project, an architectural contract for schematic drawings only can be used.

Some form of a good "construction scheduling" method should be used during construction. It can do much to expedite a project.

Perspectives and models are important planning tools and should be used to full advantage.

# 6

# Bidding Procedures

After contract documents have been approved by all concerned, bound into numbered sets, and delivered by the architect to the appropriate school official, the next phase is the selection of a firm to handle the construction of the project. There are ways, and variations of ways, that this can be done. The three principal ways are: (1) to obtain the most advantageous lump-sum proposal from contractors responding to an invitation to bid published in the area's newspapers, Dodge Reports, etc., (2) to solicit lump-sum proposals from a list of prequalified bidders, and (3) to negotiate the contract.

The method most commonly used by state schools is to advertise for bids. This is generally done by advertising in local and state papers a minimum of three times at one-week intervals. The chief objection to this method is that occasionally the low bidder will be a firm which the school has reason not to employ. Yet, unless a mighty strong case can be made against the firm, the school will be required to award the contract to the unwanted firm. (See examples of advertisements for bids in Appendix C.)

The contracting industry has done much at all levels to police its own ranks and to encourage its members to maintain high professional standards. The following excerpts from the Constitution of the Associated General Contractors, Utah Chapter, will illustrate the point:

*(a) To make membership in the Association a reasonable assurance to the public of the skill, integrity, and responsibility of its members. (b) To main-*

*tain the standards of contracting business at the level necessitated by its professional character and to establish members of the Associated General Contractors of America in the public mind as contractors who fulfill obligations in good faith . . . (d) To promote more cordial and cooperative relations between General Contractors and those with whom they deal or have contact in construction . . . (h) To eliminate waste and reduce construction costs through cooperation with other agencies in construction.*

Bids for a project may be solicited by the architect if the school desires and approves, or the solicitation for bids may be handled by the appropriate school department. Most state schools have a fairly standard "Announcement for Bids" that is sent to newspapers announcing the type of project and including a very brief statement of what it consists of, where plans are obtained, and when, where, and at what hour the bids will be opened and read aloud.

If invitations to bid on a project are to be offered to only a select group of prequalified bidders, no newspaper announcements would be made, but an "Invitation to Bid" letter would be written to each firm, giving all the necessary information and inviting them to submit a bid. A typical letter of this sort may be seen in Appendix C.

Once a project is put out for bid, it matters not by what method, questions will start coming to the architect and to the owner over the telephone, in letters, and through personal visits from contractors, subcontractors, and material suppliers. Each will be seeking clarification of something in the plans and specifications that is not clear, or that may be lacking altogether. Some may be looking for an advantage of some sort that will give them an edge over their competitors, and for that reason, only written questions should be accepted and answers given only by addenda.

It is a rarity when a project is bid and let for construction without the necessity for issuing an addendum or addenda somewhere between the asking for bids and the opening of bids. Such addenda become as much a part of the plans and specifications as if they had been a part of them in the first place, and they must be properly and carefully issued and accounted for. Each addendum will carry a number and a date and will list changes and additions to the plans and specifications by reference to page numbers, details, sections in the specifications, or any other way necessary to make the changes clear and understandable. Addenda should always be sent to all plan holders by registered letter, acknowledgment of receipt requested; or, if time is short, the addenda should be hand delivered and a receipt obtained from the person accepting each addendum. (An example of a receipt for an addendum will be found in Appendix C.)

The following is a typical section that could be inserted in the Bidding Documents covering this important subject:

Section _ Addenda

1. During the bidding period, any and all additional instructions, clarifications, interpretations, or modifications shall be made by an addendum prepared by the architect, his engineers and/or the owner and signed by the owner's representative.
2. The addendum shall be delivered, either by the owner or by the architect, as agreed upon by the two.
3. If the addendum is delivered in person, a signed receipt shall be received by the deliverer. If the addendum is to be mailed, it shall be mailed by the fastest delivery method and it shall be sent by registered mail with a signed receipt requested.
4. No one is authorized to make any clarifications, interpretations, or modifications or to give any instructions to the bidders during the bidding period except by the above-described method.

No verbal interpretations of plans and specifications should be made to any individual by the architect or anyone else. If a change is to be made or an interpretation given, it should be done in an addendum approved by the architect and the school's representative, and all plan holders should receive the exact same information at as near to the same time as possible. Each bidder should show in his "Bid Proposal" the number of addenda he received during the bidding period. If a contractor failed to get the same addenda as all the other contractors, his bid would be prepared from a set of documents different from those used by the bidders who did receive them all. Often one addendum will not greatly affect the outcome of the bidding, but it is quite possible that one could amount to a considerable sum of money and greatly affect the bidding. What to do about it, if and when it happens, will have to be decided by the architect, representatives of the state or governing body, representatives of the school, and perhaps a couple of contractors. The best way to prevent the problem is to handle addenda as though they were negotiable at the bank or a local supermarket.

Many contractors have attempted to obtain contract clauses that would permit their payments to rise as prices rise. However, this is not generally approved by the construction industry. Rather than have the owner assume the burden of price increases, weather, and other risks of the construction business, it would be better if contractors would give closer attention to these problems when bidding a job. From the standpoint of the school it is certainly desirable to have a firm bid, and it should be no hardship on a contractor who is well aware of possible shortages and rising cost trends.

**Prebid Conference.** On large, complex projects in which many people are involved in making "take offs" and in studying plans and specifications preparatory to putting their bids together, prebid conferences have proven beneficial. Contractors, as well as subcontractors, get a chance to ask questions of those who prepared the plans and wrote the specifications. Explanations and answers can be given by those best qualified to do so. Perhaps the best time to schedule a prebid conference is about midway between going out to bid and the bid opening date. This gives the contractors time to know if they have questions to ask, and time enough afterwards to put it all together.

A word of caution, however: Make it perfectly clear at the very beginning of the conference that nothing is official if it is not in writing. Questions can be discussed to improve understanding of the plans and specifications, but no one should be allowed to leave the meeting unless he understands that the documents stand unchanged until an addendum is issued. As soon as possible after the conference, the architect should issue an addendum covering all items discussed at the conference that require official clarification.

The following is a suggested agenda for holding a prebid conference:

### Agenda for Prebid Conference
### (Name of Project)

**Time.** Tuesday, April 3, 1976, at 10:00 a.m., CST
**Location.** Center — *General Meeting*, Room 321 (Little Theater)
**Conducting.** Owner's Representative

1. Greetings and welcome
2. Introductions
    a. University officials
    b. Architect
    c. Structural engineer
    d. Mechanical engineer
    e. Electrical engineer
3. Explanation of purpose of meeting
4. Official communique by duly authorized addendum only
5. Format of meeting
    a. General questions applicable to all present
    b. Owner, architect, mechanical engineer, electrical engineer, and structural engineer at individual tables for questions and discussions
6. Explanation of bidding procedure: base bid, contractor's multiple choice and substitutions
7. Utilities to the project
    a. Separate contract
    b. Cooperate and coordinate with each other
8. Adjourn conference as people leave or at noon
9. Compare notes, reach decisions, and issue an addendum on items requiring explanation.

Where and when bids are to be opened are generally agreed upon by the architect and a representative of the school. Tuesdays, Wednesdays, and

Thursdays are the preferred days, and 2:00 p.m. and 3:00 p.m. are the hours most preferred for opening bids. There does not seem to be any one official who most often opens bids, but bids are frequently opened by the director of Physical Plant, the purchasing agent, the financial vice-president or his assistant, the architect, or some state official. Most bid openings are conducted at the school, but quite a few are opened in state offices.

The bid opening is a serious and important occasion.

Immediately following the opening of bids, it is wise to thank all bidders for submitting bids and invite them to submit bids the next time the school has a project to let. It is also good policy to ask the second and third low bidders to keep their plans and bids intact until the submission by the apparent low bidder has been examined. There could be a problem that would result in rejection of the low bid and even the second low bid. All other bidders should be requested to turn in their plans at the earliest possible date and get their plan deposits back for all contract documents returned in good condition.

As soon as possible after the bid opening, the project architect and representatives of the school should meet with the low bidder to examine his bid. Some items that should be discussed with the contractor and carefully investigated are

1. Any irregularities in the bid,
2. How the contractor feels about his bid,
3. Who his superintendent of construction will be,
4. When he would like to start work,

5. What method of construction scheduling will be used, and
6. The subcontractors he proposes to employ.

If it is determined that he has bid in accordance with the contract documents and that there are no apparent irregularities in his bidding, the next most logical question is, "How do you feel about your bid?" If he has left a large sum of money on the table, he could be running scared and might even be looking for an excuse to renege on his bid. If he made an honest error in putting his bid together and can prove that he did, it will be up to the owners to decide what to do. For legal reasons or otherwise, the low bidder might be required to honor his bid. If so, there will be real need for close supervision and inspection of the project throughout its entire time of construction. It might be decided to let him withdraw his bid and then turn to the next low bidder. It is always to be hoped, however, that the low bid will be within the budget, that there will be no serious irregularites, and that the low bidder will say, "I have examined my bid and feel all right about it. When can I go to work?"

At that point, it is in order to ask who his construction superintendent will be. After a full discussion, the contractor, the architect, and the school's representatives should be in agreement. This question should not be treated lightly. A really good construction superintendent is a prize worth fighting for. At this time it might also be decided when actual ground breaking will be done. This will depend on how long it will take to prepare a construction contract and get the necessary approvals, and whether there is to be an official ground-breaking ceremony.

It is important to let the contractor know that he must promptly submit for approval a realistic "Schedule of Construction" detailing how he intends to build the project. If time is of great importance (and it nearly always is), it is very important that the construction schedule be carefully and realistically prepared, kept current, and referred to constantly. See pages 138-41 for a discussion of construction scheduling.

If everything is in order up to this point, the subject of subcontractors should be thoroughly discussed. The contractor should already have prepared a list showing the principal subcontractors and the amounts of their bids that he used in putting his bid together. If he does not have such a list, it would be wise to have him submit a list for review prior to awarding a contract. (See an example of a principal subcontractor questionnaire in Appendix C.)

*Following bid opening and a selection of a successful bidder the general contractor meets with the state and university officials for review of the sub-contractors which he proposes to use on the project. During this review,* *the university has the privilege of objecting to any of the proposed subcontractors. The university's objections are generally seriously considered and may be honored if we have sufficient written documentation on file with the State Department for Finance and Administration prior to the bid opening to substantiate our objections.*[1]

"We request the contractor to submit a list of all sub-contractors and reserve the right to accept any or all sub-contractors. This list is submitted at the time the general contractor submits his overall bid."[2]

"We do not reserve the right to approve or disapprove sub-contractors used by general contractors in putting their bids together—we would like to, but state pre-qualification is an impossible barrier to overcome."[3]

On a large school-building project, the general contractor is often little more than a broker. Perhaps seventy to eighty-five percent of the total project will be done by twenty to forty subcontractors and subs for the subs.

Thus, the selection of subcontractors can be most important, both to the general contractor and to the school. Yet this highly important matter is too often treated very informally, to say the least. It is not too unusual to ask the successful bidder on a project who one of his principal subcontractors, say the mechanical, will be and to have him reply, "I haven't decided yet. I'm considering a couple." It also is not unusual for a low bidder to tell which subcontractor gave him the lowest price but to admit that he knows nothing about the sub, in fact never heard of him. And yet, that sub's work might account for fifteen to twenty percent of the total cost of the project.

Part of the fault lies in the competitive nature of the business. Often a general contractor will put his final bid together just minutes before the scheduled time for opening the bids. A last-minute call from his office may have given him the name of a subcontractor who has just submitted a price considerably lower than the one the bidder was using in his bid. Perhaps he has never heard of this latecomer; but because he wants and needs the project, he scratches the name of the sub he does know and who has always performed in a most satisfactory way, and substitutes the one with the lower price and an unknown performance record. That last-minute decision could conceivably break the subcontractor, cause the general contractor to lose much of his expected profit from the project, and give the school no end of problems.

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[1] O. W. Bickel, Director of Physical Plant, Murray State University, Response to Author's Questionnaire on Planning and Construction, 1975.

[2] Peter P. Welanetz, P.E., Director of Physical Plant, Williams College, Response to Author's Questionnaire on Planning and Construction, 1975.

[3] John W. White, Director of Physical Plant, University of Mississippi, Response to Author's Questionnaire on Planning and Construction, 1975.

When a successful bidder says he has not made up his mind on some of his subs, it may mean (though certainly not always), that he is planning on doing a little shopping around to see if he can find subcontractors who will give him a lower price than the subs he used to put his successful bid together. He might tell a sub that another subcontractor has made him a price of so much to do the specified work, but, "If you will do it for x number of dollars cheaper than that, I will award the contract to you." In the first place, the whole deal is highly unethical; in the second place, everyone concerned could suffer. The sub who agreed to get under his competitor's price may find that his competitor's price was rock bottom to start with. His first alternative then will be to look for ways to reduce his cost, and too often it will be at the expense of the project—which means that the school will be the loser. He might go into bankruptcy, or he might refuse to continue on the job. No matter which of these options he chooses, everyone connected with the project loses.

All kinds of methods have been tried in an attempt to prevent bid peddling and the use by general contractors of incompetent, underfinanced, and unreliable subcontractors. There are so many good subcontractors available that settling on one would seem to be really easy. But it has not proven to be so. When those responsible for construction at forty universities and colleges in the United States and Canada were asked, "Have you developed a system to prevent bid peddling?" twenty said, "No," eleven said, "Yes," two said "Yes and no," and seven did not answer.

Those who said they had developed a system to prevent bid peddling explained their systems as follows:

1. "Contractor must submit names of major subcontractors with his bid. List of specific materials by manufacturers' names submitted within seven days. Both of above submittals are received before award is made."
2. "Receiving separate bids for general, mechanical, electrical, elevators, and laboratory. Furniture trades on single bid with major subcontractors listed on the bid form. Complete list of subcontractors may be requested no later than twenty-four hours after bid opening."
3. "All subcontracts in excess of 0.5 percent of the base bid must be identified by the prime contractor on his proposal. Any change after the award must be approved by the owner."
4. "Campus architects and engineers must review and approve subcontractor's list as submitted by general contractor. If a general contractor wishes to substitute others than those that were in the bid proposal, he must explain the reasons for the substitution and request re-approval."

5. "Major subcontractors must file copy of their proposal to general contractors with Associated General Contractors' Executive Secretary five working days prior to bid opening date. General contractors must list on their bids the major subcontractors and amount of subcontract. After general contractors' bids are opened, filed sub-bids are opened and compared with general contractors' bids. Any differences are corrected based on filed sub-bid prior to selection of low bidder."
6. "On large single contract projects, the mechanical, electrical and other major equipment bids are opened at 10:00 a.m. at a public opening attended by the general contractors. The general contractors use the successful bidders, as determined by the opening, in submission of their single contract bid at 2:00 p.m. the same day."
7. "Require sub-bidders list with opening of bids. Review request for change very thoroughly."
8. "On some projects, both major and minor, certain critical subcontractors are required to be named on proposal."
9. "Upon award of contract, the prime contractor is required to submit a list of subcontractors who will be working on the job. No changes in this list are permitted without the consent in writing of the University."
10. "Bid component sub-systems separate and assign to general contractor."
11. "Each bidder shall include with his proposal a list of subcontractors (where provided on the form of proposal) together with the dollar amounts of their bids which were used by him in formulating his proposal. (The owner reserves the right to accept or reject any listed subcontractors. Should a subcontractor be rejected, the owner will increase the construction contract in an amount representing the difference in the bid of the rejected subcontractor and the bid of the next subcontractor who is acceptable. This will be accomplished by an *extra* to the construction contract.)"

"A disqualified list of sub-contractors is maintained by the Department of General Services. If a contractor is on this list, he will be disapproved. This system does not disqualify a sub-contractor unless he has a previous record with the state."[4]

"We have a very small list of sub-contractors with which we have experienced dissatisfaction, and we will notify all prospective general contractors that these firms are not acceptable to the institution. We reserve through the Construction Documents the right to reveal all sub-contractors prior to award of contract; and sometimes, if there is one with which we found fault, and if funds are available, we have moved to the second bidder and paid the difference."[5]

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[4] Kenneth J. Hollett, Director of University Physical Planning, University of South Florida, Response to Author's Questionnaire on Planning and Construction, 1975.

"Two weeks prior to general bid opening, we hold a bid opening for the major subs (electrical, plumbing, heating, ventilation, and air-conditioning). The low bidder for each major trade is then given to the general bidders by addendum to include by name and with the amount of their bid. This encourages more competitive bidding among the mechanical and electrical contractors and prevents bid shopping."[6]

It is doubtful if any system yet devised is 100 percent successful. If a general contractor is a legitimate low bidder on a sizable project, and if he chooses to cheat on the system, he can probably find a way to do it. However, the inclusion of one of the above methods, or a combination of two or more of them, in the "Instructions to Bidders" and in the "Form of Proposal" is definitely recommended.

Recognition is given to the Construction Practices Council of New Mexico, Incorporated. This group was formed under the guidance of M. F. Fifield, then director of Physical Plant at the University of New Mexico. Its membership consisted of engineers, architects, general contractors, subcontractors, material suppliers, and owners representing schools, institutions, and business firms in the state. This group has now been dissolved, but the effort these people made to develop better business conditions and methods, and higher business and professional standards and ethics in the construction industry and groups closely allied with that industry in the state of New Mexico is exemplary. During the time it functioned, it accomplished a great deal. The work it did is not lost: its assets and many of its purposes have been transferred to another organization, and hopefully its good work will continue. It was a good example of democracy at work, and its accomplishments will be beneficial to all concerned.

**When Low Bid Exceeds Available Funds.** Any school doing very much building may occasionally find itself in the unpleasant position of opening bids on a badly needed project and discovering that the lowest bid exceeds the available funds. When this happens, there are several possibilities to be considered:

1. Sit down with the architect and his engineers and with the general contractor who was the low bidder, and see if enough substitutes and changes

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[5] Wayne McMurtry, Director of Administrative Services, University of Southern Colorado, Response to Author's Questionnaire on Planning and Construction, 1975.

[6] James A. Ward, Director of Physical Planning and University Architect, Duke University, Response to Author's Questionnaire on Planning and Construction, 1975.

can be realized to make it possible to construct the project within the budget. (Quite often a considerable saving can be accomplished without seriously affecting the appearance or functional use of the project.)
2. Go back to the original source of funding to see if the budget can be increased sufficiently to allow the project to be constructed.
3. A combination of 1 and 2. (Negotiate as much as possible for the low bidder and try for additional funding to make up the difference.)
4. Rework the plans and specifications and reduce the scope of the project sufficiently to allow potential bids within the budget. (The problem with this choice is that, unless the architect and his engineers exercise great care, the revised plans and specifications will have so many inconsistencies in them that expensive problems may, and probably will, develop during construction.)
5. Discard the plans and specifications, prepare a new program of requirements, redesign the project, and hope for the best the next time around. (The danger here is that construction costs may escalate so much in the meantime that the project, after it has been simplified and reduced in scope, may result in bids as high as, or even higher than, the original project.)
6. Scrap the project completely. (Hopefully it will never come to this.)

The method commonly used to prevent having to do any of the drastic things mentioned above is to have one or more alternates specified. There are two types of alternates. One *deducts* or *subtracts* from the project, and the other *adds* to the scope and cost of the project. An example of a *deductive* alternate is as follows: A school's plans for a residence hall also included a pedestrian bridge across a busy street. However, the architect and the owner were fearful that the added cost of the bridge would cause the project to exceed available funds, so they decided the bridge would be considered as a deductible alternate. The plans were drawn and the specifications so written that all bidders would submit a quotation for the entire project including the bridge, but the bidders would also show on their bid proposals, in the place provided for alternate proposals, their price for doing the bridge. The bidding documents indicated that the bridge was a "deductible alternate." When the bids were opened, all of them exceeded the available funds. However, by taking the low bid and subtracting the alternate bid for the bridge, it was possible to build the residence hall within the budget, although the bridge portion had to be omitted.

An example of an "add alternate" is as follows: The plans for the residence hall include a pedestrian bridge over the street; but the plans were drawn, and the specifications written, so that the low bidder would be determined on the basis of the residence hall *only*. The bridge over the street was bid as an "add on alternate" and did not have any effect in determining the low bidder for the residence hall. When the bids were opened, there were two possibilities: One was that the successful bidder's price for the residence hall, added to his alternate bid for the bridge, might exceed the available funds, in which case the alternate bid on the bridge would not be accepted and a contract would be prepared for the residence hall only. The other possibility would be that, when the successful bidder's price for the residence hall was added to his alternate bid on the bridge, the total of the two would be within the budget, allowing a contract to be drawn for the construction of the residence hall and the bridge over the street.

The above illustrations were of a very simple bidding procedure. However, when there are several sizable alternates taken of either method, a bid opening can get complicated in a hurry. By picking and choosing alternates, the school can direct the contract to almost any contractor of its choice. But the result would most likely be some contractor accusing the school of foul play. Perhaps the best way to prevent this from happening would be to state in the bid documents the order in which the alternates would be considered. In other words, place an order of priorities on all alternates. This has an objection as far as the owner is concerned in that it does not allow full freedom of choice when the proposals are all opened. At that stage, the owner might wish to take advantage of a particularly favorable bid on an alternate but find it hard to do because of earlier established priorities.

A deductive alternate is probably less desirable than an add alternate because generally the contractor will not give back the full amount.

Alternates can create problems, but they can help solve money problems. Do not use them unless the situation demands it, and when they are used, try hard to cross every 't' and dot every 'i' in an effort to have a clear and undisputed bid opening.

*Another procedure, when several alternates are included, is to establish that the project will be awarded on the basis of the low base bid and that the alternates submitted by the low bidder will be incorporated as the Owner desires. This will establish a fair bid award and will give the Owner the opportunity to incorporate such alternates as he desires. Its disadvantage lies in the fact that this may not produce the lowest possible price for the project in that the low bidder may have an alternate or two that are higher than those presented by other contractors, but it does introduce a greater degree of fairness in making the award.*[7]

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[7] Fred L. Markham, F.A.I.A., Markham and Markham, Architects and Engineers, Provo, Utah, Written Statement to Author, 1975.

## Summary

Prices for construction of a project may be obtained in several ways. It is in the school's interest to select the method best suited to its needs. Addenda become official parts of the contract documents and must be fully prepared and transmitted carefully. No interpretation of contract documents should ever be made except in writing. Prebid conferences can be very helpful to all concerned. A number of important things should be done immediately following bid openings. Construction scheduling is most important. Subcontractors should be designated either before or immediately after a bid opening to allow the school an opportunity to approve or disapprove them as a means of preventing bid peddling. Alternate bids can create problems, but they can help solve money problems. Several courses of action are open when the lowest bid received exceeds the amount of money available.

# Part 2: Construction

# 7

# Construction Procedures

**Construction Contracts.** Once the bids have been opened and an acceptable low bidder determined, and when all conditions have been discussed and mutually agreed upon between the low bidder and the school, it is time to prepare a construction contract. If the school has a planning office, the contract will most likely be prepared there. If the school does not have a planning office, the contract can be prepared by the architect.

There are many kinds of construction contracts. If a school has not already done so, it would be wise to develop typical forms suitable for the different sizes and types of construction work proposed. For small jobs a short form contract would most likely be all that is required. For large projects, the contract would be longer and more detailed.

The contract might provide for the school to purchase certain items, or it might not. The basic contract might provide for separate subcontracts. In any case, the purpose of the contract is to set forth clearly the responsibilities of the contractor to the school and of the school to the contractor. It is a legal document and should be prepared with the advice and help of legal counsel. Not only should the typical forms be prepared with legal help, but each individual construction contract should be examined and initialed by a member of the school's legal staff before it is submitted for signatures.

Most schools who have had building programs have already worked out their own construction contract forms; therefore, no details will be given here. However, some examples of construction contracts that might prove helpful are reproduced in Appendix C.

The title of the official who makes the final decision to award or not to award a construction contract will vary greatly from school to school as does the official who finally, after everything is in order, writes or prepares the construction contract. The president of the school and the contractor will sign the construction contract. There will be other signers, depending on the school and governing body policies. Also, it is generally required that signatures be notarized. (See Appendix C for an example of the "notice to proceed with construction.")

When the construction contract has been fully executed, the fun of construction begins. Construction *can* be fun—if the owner has done a good job of programming his functional requirements, if the architect has done a good job of interpreting those requirements and in developing a complete and well-coordinated set of contract documents, and if the contractor is a man of integrity and experience, is cooperative, and has a group of subcontractors who are also experienced and cooperative. If any of these elements are missing, the construction period may have its unpleasant moments and the finished product may leave something to be desired.

A construction project requires a cooperative team effort on the part of the architect, the contractor, and the owner. Each has his rights and responsibilities, and those rights and responsibilities should be known and respected by all.

*The Architect.* The architect is concerned that the plans he has worked so hard to develop are properly interpreted and constructed accordingly. He is concerned that the finished product be functionally acceptable, structurally sound, and aesthetically pleasing. He wants the owner to be well satisfied, but he also wants that feeling of professional pride that comes from knowing he has created a project of architectural excellence.

*The Contractor.* The good contractor also has his professional pride. He is interested in constructing a project of good materials and good workmanship. He wants the architect and the owner to be pleased with the finished product. He would like to be able to say truthfully to his children and his grandchildren as they ride by, "There is a good building; I know it is a good one because I built it." But he is also concerned with cost. When he accepted the responsibility of constructing the project, he gambled that he could satisfy everyone and still make a profit. Always that concern over profit and loss is there, and his actions and attitude are often influenced by how well the project is doing financially. (This is an important reason why it is not wise to hold a contractor to his bid when he can prove that he made an honest and substantial error.) The architect and the owner, after the contract is awarded, might be sympathetic with the contractor's financial worries, but their main concerns lie in different directions. The contractor bid on a set of contract documents prepared by the architect and approved by the owner. It is his responsibility to construct the project according to those documents. Any variance from the plans should be approved by both the architect and the owner and given to the contractor in a written change order. He should not make changes on the verbal request of the owner or the architect. But how he chooses to construct the project is his choice.

*The Owner.* The owner wants everything that the architect wants, and everything that the contractor wants, except his financial risk. However, his desires and attitude are often influenced by the fact that it is his money that is allowing the architect and the contractor to make substantial profits. Occasionally he may even feel that, because he is paying for it all, he should have the final say on architectural and contractual matters. But the knowledgeable owner will not take that attitude. He can work with the architect and make many suggestions; he can have much to say about functional arrangements, about location of the project, and about the choice of materials. However, the architect was employed because of his professional knowledge of all these items, and much more, and his thoughts and recommendations should be given prime consideration.

The owner has certain rights with respect to the construction work, but he should not issue direct instructions to the contractor or any of his work forces on methods or procedures, nor should he interfere with constructional operations. On the other hand, if an impasse is reached because the contractor or one of his subcontractors refuses to follow plans and specifications, or because their work is so inferior that it is unacceptable, it is within the owner's authority to order the project shut down until matters can be worked out to the satisfaction of the architect and the owner. (However, shutting down or "stopping the work" can get complicated legally for both the school and the architect. The best procedure, when possible, is to get the contractor to stop all work himself until the problems are solved.)

One of the keys to a successful construction project is good will and a cooperative attitude on the part of the architect, contractor, and owner. Dialogue is important, and a good way to maintain it is to keep all lines of communication open and operating.

**Preconstruction Conference.** It has proven to be highly desirable to have a preconstruction conference. This is held immediately after a construction contract has been fully executed and before construction has begun. School representatives, the architect and his principal engineers, the general contractor and his superintendent of construction for the project, all subcontractors, and any others closely associated with the project should be present.

The purpose of such a conference is to get acquainted and to discuss the several phases of the project which, when understood by everyone, will make the job run smoothly. The meeting would start with a brief statement of the purpose for such a meeting. Next, each person present would identify himself both by name and position. The person conducting the meeting would establish lines of authority as well as the lines of communication that should be followed during construction. The meeting would then move into a discussion of items of interest to all present. The items discussed would vary, depending on the project, the organizational structure of the school, and several other factors, but the following agenda of a Brigham Young University preconstruction conference will suggest items that might logically be discussed.

### Agenda
### Preconstruction Conference
________ University

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|---|---|
| Time | Wednesday, 2 April 1976—10 a.m. |
| Place | Physical Plant Department Conference Room |
| Conducting | Owner's Representative (Part One)<br>Construction Engineer (Part Two) |
| Present | Owner's representative<br>Dean, School<br>Chairman, Campus Planning Committee<br>Construction engineer (School)<br>Assistant construction engineer (School)<br>Chief building inspector (School)<br>Architect (outside)<br>Structural engineer (outside)<br>Mechanical engineer (outside)<br>Electrical engineer (outside)<br>General contractor<br>Superintendent of construction<br>Major subcontractors |

(Part 1)

1. Welcome and Introduction (Owner's representative)
    a. Dean, School
    b. Architect
    c. Engineers
    d. Physical Plant personnel
    e. General contractor
    f. Subcontractors
2. Line of Authority
    a. Owner's representative

- b. Construction engineer (School)
- c. Assistant construction engineer (School)
- d. Chief building inspector (School)
- e. Architect (Outside)
- f. Engineers (Outside)
- g. Administration and Faculty

3. Changes in work
   - a. Job instructions
   - b. Change orders
4. Critical path
   - a. Progress schedule
   - b. Weekly job meetings
5. Separate contracts
   Extension of utilities to building
6. Emergencies
   List of names and phone numbers of responsible local people
7. "As-built" drawings and manufacturers' operating instructions
8. Approval of materials and colors
   - a. Cast stone
   - b. Brick
   - c. Submittal of all samples to architect
9. Who to listen to, and who not to listen to
10. Owner has a contract with the general contractor and not with the subs
11. Let's make it a team effort
12. Completion schedule
13. Keep the job clean
14. We expect a good job and know you can do it.

(Part 2)

1. Job instructions
2. Change orders
3. Insurance
4. Construction checklist
5. Monthly progress estimates
6. Shop drawings
7. Construction parking passes
8. Temporary utilities (Only physical plant personnel are authorized to interrupt utilities)
9. Temporary office
10. Temporary toilets
11. Layout of building
12. Checking of building layout
13. Keys to gate
14. Use of transmittal forms
15. Parking and contract limit lines
16. Owner-purchased materials

**Bonds.** Several types of bonds are used in construction work. Schools may differ on the number and kinds that they use. Three are used commonly, and the following is a brief description of each.

*Bid Bonds.* When forty schools were asked if they required a bid bond, thirty-five said that they did and only four said they did not. One school requires either a certified check, a cashiers check or a money order. The question was then asked, "Do you hold a contractor to his bid when he has made an honest and substantial error in putting his bid together?" Twenty-three said they did not, and only three said they did. Six said yes, if obvious, but with penalties; one said the situation had never occurred; and seven did not reply.

A good case can be made for not requiring a contractor to honor his bid when he has proven without a question of a doubt that he made an honest and substantial error in putting his bid together. A contractor who is in solid financial condition and is proud of his good reputation will sometimes sign the contract even when he has left a fairly sizable sum of money "on the table." A contractor not in a strong financial situation, who has made a more costly error than he can afford, is not the best contractor to have on the job anyway. When the general contractor is really hurting, the school will probably also be hurt in one way or another.

Some schools are saving the cost of a bid bond on the rationale that if a contractor who has spent a considerable amount of money preparing his bid finds he has made an error and does not want the job after he has been declared the low bidder, it will be in the school's best interest to let him go. The next step is for the school to examine the bid of the second lowest bidder and, if everything is in order, to draw up the contract with that bidder. Occasionally a contractor who has been allowed to withdraw will be asked not to bid again.

The following is a sampling of answers to two questions: (1) Do you require a bid bond? (2) Do you always hold a contractor to his bid even when he has made an honest and substantial error in putting his bid together?

"A bid bond is not required by law, but confirms credit rating. As a university invites pre-qualified bidders, normally if the lowest bid is 10 percent lower than the next, we will give him 24 hours to reconfirm his bid or allow him to withdraw and face requalification procedure." [1]

"A bid bond is not acceptable. Certified check, cashier's check, or money order is mandatory. If the contractor can prove an honest and substantial error, he may be allowed to withdraw his bid. We occasionally suggest that he refrain from bidding future jobs." [2]

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[1] John K. Armour, Director of Physical Plant, York University, Ontario, Canada, Response to Author's Questionnaire on Planning and Construction, 1975.

[2] Ronald T. Flinn, P.E., University Engineer, Michigan State University, Response to Author's Questionnaire on Planning and Construction, 1975.

"A bid bond is required by law on projects of $2,000 or more. Generally, contractors who have promptly notified the state engineer of a gross error in their bids have been permitted to withdraw the bid. One or two contractors have forfeited bid deposits rather than sign contracts."[3]

"Only on rare occasions do we require a bid bond. In making up a selected list of contractors, we take financial conditions into account."[4]

"Required by law. If a contractor can prove he has made a substantial error, he may be allowed to withdraw his bid. If this happens, the project would be rebid."[5]

"It is required by law. The State has allowed a bidder to retract when the error is an obvious one, but he was not allowed to do so without forfeiting his bid bond."[6]

"We have excused contractors from executing contract when it was obvious he had made a substantial error. Usually he is prevented from bidding again for a period of time as punishment."[7]

"If contractor can prove honest and substantial error within five days after bid opening, bidder is released from proposal. After second similar occurrence within a two-year period, contractor is disqualified for a year."[8]

"If contractor requests permission to withdraw his bid, we ask for justification. If he submits data evidencing mathematical error in preparation of bid, he will generally be permitted by the Board of Curators to withdraw his bid. If he has failed to include all of the work and materials involved in the project, no relief is granted."[9] (See examples of a bid bond in Appendix C.)

*Performance Bonds.* The performance bond is a document designed to protect the school against a contractor's failure to perform. Forty schools were asked if they require a 100 percent performance bond. Thirty-five said they

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[3] Ken S. Hayter, Director of Physical Plant (retired), South Dakota State University, Response to Author's Questionnaire on Planning and Construction, 1975.

[4] Peter P. Welanetz, P.E., Director of Physical Plant, Williams College, Response to Author's Questionnaire on Planning and Construction, 1975.

[5] Kenneth J. Hollett, Director of University Physical Planning, University of South Florida, Response to Author's Questionnaire on Planning and Construction, 1975.

[6] Wayne McMurtry, Director of Administrative Services, University of Southern Colorado, Response to Author's Questionnaire on Planning and Construction, 1975.

[7] A. W. Blass, Director of Physical Plant, Southern Illinois University at Carbondale, Response to Author's Questionnaire on Planning and Construction, 1975.

[8] Richard A. Eustis, Director of Physical Facilities, University of Maine, Response to Author's Questionnaire on Planning and Construction, 1975.

[9] Raymond Halbert, Director of Physical Plant and Construction, University of Missouri, Response to Author's Questionnaire on Planning and Construction, 1975.

*did*, three said they *did not*, and two said 50 percent only. A performance bond need not be written for 100 percent. It can be written for a lesser amount, depending on how much protection the school feels is needed. Its purpose is to protect the owner against default. If the contractor goes broke before the project is finished or otherwise fails to perform according to the terms of his contract, the bonding company will see that the project is completed. The contractor should apply for the bond as soon as he is awarded a contract, and the bond will be paid for by the contractor; but because its cost is included in his bid, the school actually pays for it.

Although it is good practice to require a performance bond, it is also wise to take every precaution before and after signing a contract to forestall having to call upon the bonding company. When it becomes necessary to turn a job over to a bonding company, the owner may have problems, frustrations, and delays. A performance bond is an important protection to the school, but all parties concerned should hope that it will not be needed. (See an example of a performance bond in Appendix C.)

*Labor and Materials Bond.* The labor and materials bond is a guarantee that the contractor's bills for labor and materials will be paid. Having this bond greatly reduces the possibility that a subcontractor or a material supplier might place a lien against a project because of the failure of the contractor to meet his financial obligations so far as labor and materials are concerned.

More could be said about the details and importance of a labor and materials bond, but it is not necessary to do so here. However, it is strongly recommended that a 100 percent labor and materials payment bond be required on all projects of any real size, and it is further recommended that the school reserve the right to approve the bonding company. The cost of the bond should be the obligation of the contractor, and it should be delivered to the school as soon as possible after the execution of the construction contract. (An example of a labor and materials bond will be found in Appendix C.)

There are other sureties that a school might require, but the three just described are the most common; and of the three, the performance bond and the labor and materials bond are the two most important.

Insurance. In addition to the required bonds, the contractor must also carry proper insurance. Neither he nor his subcontractors should be allowed to start work until they have adequate and appropriate insurance and have supplied the school with certificates of that insurance. The cost of insurance is included in the bid.

*Liability Insurance.* This should cover (1) the workmen's compensation and the employer's liability insurance required by statute, (2) comprehensive general liability to cover bodily injury and property damage in the desired amounts, (3) comprehensive automobile liability to cover bodily injury and property damage in the desired amounts for owned and nonowned, including hired vehicles, and (4) owner's protective liability to cover bodily injury and property damage in the desired amounts.

*Builder's Risk Insurance.* The school should require the contractor to furnish a builder's risk insurance policy. The policy can be written for whatever amount is felt necessary to protect all parties concerned. Most likely it will be in the full amount of the contract price. Of course, the cost will depend upon the amount of coverage specified. The purpose of a builder's risk policy is to protect the contractor, subcontractors, owner, and all others involved against fire, lightning, windstorm, hail, civil disturbances, smoke, aircraft, vehicle, explosion, riot, vandalism, malicious mischief, and anything else felt to be needed and made a part of the policy. The cost of the insurance should be included in the bid amount. The policy should be checked by the school's legal counsel to make sure that everyone involved is properly and adequately covered.

**Hold Harmless Agreement.** In addition to obtaining insurance coverage, the contractor should indemnify and save the owner, architect, and their agents and employees harmless from any and all liability, demands, causes of action, claims, and so on. This agreement should be checked by the school's legal counsel. (See Appendix C for an example of an indemnity bond.)

**Liquidated Damages.** A liquidated-damage clause is frequently included in construction contracts. Its purpose is to insure that the contractor will finish his project within the time limit specified in his contract. Of the forty schools contacted, twenty-nine said they did insert a liquidated damage clause in their construction contracts, ten said they did not, and one did not reply. Fourteen schools indicated that they have collected liquidated damages. It was surprising that only three schools of the forty indicated that a bonus was ever offered for an earlier completion than that called for in the contract.

It has been questioned as to whether or not a liquidated damage clause is legal if a bonus clause is not also offered. However, it seems to be more a question of whether the attempt to collect is based on a costly damage to the school caused by undue delays, or whether it is being assessed more as a penalty for noncompliance; also, whether the daily amount stipulated for noncompletion of the project by a specified date is reasonable. It might be ruled that a school should have $250 per day for failure to complete on schedule a residence hall for which students had been accepted and for which they had paid money entitling them to occupy by a certain date. Failure to complete this project on time could cause the students great inconvenience and could cost the school a considerable amount of money. On the other hand, a $500 per-day damage suit against the contractor for not completing the Physical Plant building on schedule might be judged as an attempt to penalize the contractor rather than to compensate the school for any real financial loss.

It is important that all parties concerned understand clearly the exact date liquidated-damage will start. Liquidated damage might be figured as so many calendar days from the official starting date, or it might be determined as so many working days. It is the contractor's responsibility to notify the owner immediately (say within ten days) if anything has occurred which in the contractor's judgment would be cause for an extension of his contract. It is also important to have a clear understanding about what is meant by completion. If the project is substantially completed and is far enough along that it can be used by the owner, it might be ruled that the contractor had satisfied the liquidated-damage clause, even though the owner might not agree.

The liquidated-damage clause is a good one to have in a construction contract whether or not any money is ever collected. It gives the school's representative a strong hand when he is pressing the contractor to finish on schedule. It also gives the contractor a strong hand to use when he is putting the pressure on a group of slow or indifferent subcontractors to "get in and get out" so that he, the general contractor, can finish on schedule. A general contractor's threat to pass on to his subcontractors a portion of any liquidated damages he might have to pay will often have a salutary effect on the subcontractors.

In the final analysis, all that the school should want is for the project to be finished by the scheduled date, so that it can be put to its intended use. As an aid in accomplishing that objective, a liquidated-damage clause is useful. However, a realistic time limit should be specified, taking into consideration such things as weather, material shortages, poor deliveries, strikes, the labor market, and even O.S.H.A. Also, the money stipulated for each day the project is not finished under the terms of the contract should be a reasonable amount based on potential monetary loss to the school rather than an amount that could be ruled as solely a penalty against the contractor.

**Bonus Clause.** A bonus clause may be included in a contract when a school is so desirous of having a project finished on or before a certain date that it is willing to pay a contractor a stipulated sum of money for each day the project is finished ahead of the completion date specified in the contract.

Let us look again at the residence hall: it could be very important that the hall be ready for occupancy by several hundred students at the beginning of the fall term, so important that the school could afford to offer the contractor a bonus of x number of dollars per day for each day the project is finished prior to August 15, the scheduled completion date of the project. Failure to complete the project on schedule might cause the residence hall to stay largely unoccupied for several months. This could cause serious problems to the students who had counted on living there, and it would represent the loss of considerable revenue that the school had counted on to help finance the project. By offering a bonus, the owner might enable the contractor to work overtime and deliver the project on schedule where otherwise he could not, or would not, do so. The amount of the bonus would depend on the size of the project and on how desirous the school was to have the project completed on schedule. It would need to be large enough to make it worthwhile to the contractor.

**Additional Matters of Importance.** At the last moment, when plans and specifications are being finalized, during the excitement of opening bids, awarding the contract, and getting a new project started, some very important things are occasionally overlooked. The following items should be given careful consideration:

*Superintendent of Construction.* The construction superintendent is the general contractor's representative for the project and, as such, is a most important man. There are superior, good, poor, and downright bad superintendents. The kind of superintendent working on the job will often determine whether or not the job is finished on schedule, whether or not there are labor problems, the number and cost of extras, and many other things that can vex and frustrate everyone concerned. On the other hand, the superintendent can cause the job to run so smoothly as to be a pleasure to everyone.

The school should demand to know who the general contractor proposes to use and, if necessary, insist on another superintendent if it is known that the one proposed is not of top ability. Once the identity of the superintendent is determined, his name should be designated in the construction contract.

Pulling a good superintendent off the job when it is about 90 percent completed and turning it over to a carpenter foreman or to someone with considerably less experience and ability than the man just removed is not uncommon, but should be discouraged. It would be well to have an understanding in the beginning that this is not to happen without the written consent of the school. It would also be well to have an understanding that the owner will insist that the superintendent be removed if he proves unsatisfactory to the owner.

*Authority of Construction Superintendent.* Should the construction superintendent have the authority to make key decisions in the absence of the general contractor? There have been cases where the superintendent of construction was such a "figure-head" that he lacked authority to purchase nails without an okay from the contractor. Obviously, if the superintendent is a good man and if he is expected to keep the job running smoothly and on schedule, he must have considerable freedom of action. It is recommended that this be discussed with the contractor before the construction contract is signed.

*School's Representative.* The name of the school's representative should be included in the construction contract as well as the name of the contractor's superintendent of construction. He should be the liaison between the school, the architect, and the contractor. All important questions, problems, and decisions should channel through him. He should have the authority to initiate and approve change orders and to do what is needed to keep the project running smoothly, on schedule, according to approved plans and specifications, and within the approved budget. An important part of his duties is to always keep his "boss" and other designated school administrative personnel informed and to seek their advice and approval on policy changes and financial matters.

*Subcontractors.* All subcontractors should be thoroughly investigated before the construction contract is signed. Many will be known well enough to allow an immediate decision as to their ability to perform. Generally, however, there are also a few that are not known to the architect, the contractor, or the school. These should be investigated very thoroughly. The best way to do this is to find out what jobs they have worked on, and then have the architect or a school representative contact the architects and contractors responsible for those jobs. If the subcontractors have a good performance record, all well and good; if not, an important decision needs to be made.

*Supervision and Inspection of Construction.* It is most important to let the contractor and his principal subcontractors know who will represent the school on inspections of their work. Sometimes it will be the outside architect; sometimes, the school architect. Occasionally it will be staff members from the construction department of the school, but most often it will be authorized personnel from the Department of Physical Plant. Whatever the procedure is to be, it must be made clear to all concerned. It is especially important that the contractor and his superintendent know who has the responsibility for supervision of construction and day-to-day inspection. Lack of clear understanding on this important matter could cause problems.

*Building Permits.* The contractor is normally responsible for securing the necessary building permit, but the school pays for it—although the school may have an agreement with the city to refund all or a part of the fee for the building permit. The permit should be one of the first things the contractor takes care of after he has been awarded a contract. The contractor is also responsible for seeing that his subcontractors have the required permits. The following are some of the permits that may be required: general building permit, electrical permit, sewer connection permit, plumbing permit, and land-use permit. Some of these may not be required, but there may be others, depending on the requirements of local government.

*Temporary Utilities.* An understanding about utilities should be established with the contractor at a very early stage. Questions concerning where connections can be made and whether the school will supply them or whether the contractor will pay for them should be clearly answered. It is customary for the contractor to arrange for all necessary hookups and to pay the school for services. If the connections are made to services supplied by a municipality, the contractor would make his arrangements for services there and would be billed like any other customer.

*Substitutions.* Generally items are specified for very good reasons. For example, bids are—or should be—based on the use of specified materials. Therefore, substitutes should not be used without the architect's permission. If the contractor or one of his subcontractors feels that a product is superior to the one specified, or if the one specified is unobtainable or of slow delivery, they should report the facts to the architect. The architect should, with the school's permission, either approve or disapprove the proposed substitution. Inspectors should be constantly on the lookout to see that only specified items or approved substitutes are used—a practice that should be made perfectly clear to the contractor and to his construction superintendent before the start of construction.

*Clean Job.* It should be impressed upon the contractor that neither he nor his subcontractors are to overload trucks and scatter dirt and gravel over campus and city streets. He should also know that the school expects him to comply with all safety regulations, which includes keeping his project free from litter and trash both inside and outside.

*Surplus Dirt.* The question of where to store backfill dirt until it is needed and what to do with surplus dirt is one that the school should answer. Where there is sufficient space inside the contract limit lines to store the dirt needed for backfill, there is no problem. Often, however, the space is not available and a place must be found as close to the construction site as possible but out of the way and, hopefully, out of sight of normal campus activity. If the school has a use for the surplus dirt, it should state in the specifications the place or places to which the material will be trucked and the distance of such places from the construction site.

If the school has no use for the surplus dirt, it may choose to let the contractor dispose of it where and how he chooses. He will probably sell most or all of it to local people. The school might decide to sell the dirt, but it is generally more bother than it is worth.

Of course, all topsoil should be carefully removed and stored in a convenient location before any deep excavation is started. The school landscape architect or grounds superintendent should oversee this operation to be sure that all soil good for growing plants is saved for future lawns and landscape plantings.

*Contract Limit Lines.* Construction plans should indicate the boundaries of the construction area. It is expected that the contractor and his subcontractors will keep their work, including on-the-job materials, within that area. Immediately after signing the contract, the school's representative and the contractor should walk over the area and agree on the contract limit lines. Normally a fence of some sort is placed around the designated area: sometimes the school supplies the fence, thus saving the project that cost; at other times the contractor supplies it. Either way, the fence should become school property when the project is finished. Those decisions need to be made by the architect and the school's representative and specified in the contract documents.

*Siting the Project.* It is the responsibility of the contractor to locate his project in accordance with information given on the plans. However, the architect and the school civil engineer should check and double check the bench mark used, the lines run, the elevations established, and the orientation of the project. By so doing, they can catch and correct errors before they become expensive and embarrassing.

*Kibitzers.* The general contractor and his construction superintendent should be given a list of school officials whose duties require them to be in and around the project while it is under construction. They should also be notified in writing (1) who is authorized to discuss policies, procedures, and problems with them and (2) that they should tell everybody else to make suggestions through proper channels.

One problem in constructing school buildings is how to keep interested professors and students from wandering around and through a project while it is under construction. Such unauthorized persons interfere with the workmen and are likely to be injured. It is not fair to the contractor who has a schedule to meet and whose insurance premiums are already extremely high. Unauthorized persons should be kept away from a construction project unless they have made prior arrangements to visit the project. And then they should be accompanied by someone from the school planning or construction office.

*Samples.* It is the contractor's responsibility to submit for review various materials specified by the architect. It is the architect's responsibility to discuss the submissions with proper school personnel and to promptly notify the contractor of their approval or disapproval. It is important that the contractor have his masonry subcontractor "lay up" a brick or stone sample of ample size so that the architect and school personnel can review and approve the range of brick or stone color and the color and type of mortar joint proposed. The contractor should obtain proper approval of all such items before putting them into place.

*As-Built Drawings.* It is a rare project that is built without some changes from the plans. Such changes may be minor, or they may be quite extensive. Regardless, it is important that the school have in its possession, as soon after a project is finished as possible, a set of drawings corrected to reflect accurately all in-construction changes. When the project is finally closed out, the architect might be free of it, but the Department of Physical Plant of the school will be just starting that long, never-ending job of maintaining and operating it. It is essential that the personnel in the department have a complete and accurate set of as-built drawings to aid them in their work.

The architect cannot develop a set of as-built drawings at the end of a job unless he is given accurate information on the changes made during construction. Many of the changes he will initiate, and those he will have a record of; but often a change that is made will be expedient but not authorized. Building inspectors should watch carefully to see that all changes are properly noted and given to the architect. Such "minor matters" as a lost clean-out plug or a missing eight-inch water shutoff valve may not seem important at the time, but to the mechanic called out on an emergency in the middle of a cold winter night, they can be mighty important. Physical Plant personnel will be referring to the contract documents for information of all kinds throughout the entire life of the project. It is most important that the information on the "as-built" drawings agree with the actual construction.

*Weekly Job Meetings.* It is not known whether many schools hold weekly job meetings when they have sizable projects under construction, but such meetings are strongly recommended. A certain hour on a certain day should be set aside for that purpose. These meetings should be attended faithfully by the contractor or his superintendent of construction or both, by the architect, and by the school's representative and the building inspector assigned to the project. And sometimes certain subcontractors and material suppliers should attend. The purpose of such meetings, stated in simplest terms, is to "prevent molehills from becoming mountains." Many problems and misunderstandings can be resolved at these meetings, and that helps to keep the job running smoothly.

*Public Relations.* The news media always have a great deal of interest in bid openings on major projects. Immediately following a bid opening, calls will likely come wanting information on the results of the bidding, including the amounts of the bids. How such calls are handled is important from a media and public-relations standpoint. There should be a school policy on what information will be made available and who in the school is authorized to release it. The vice-president for business or the Physical Plant director might conduct the bid opening, but the policy of the school might be that information about the bid opening would be handled by the school's publicity director. At one school the Physical Plant director conducted bid openings for his school. He had an understanding with the Office of Press Relations that *he* would not release information on bid openings if *they* would not construct buildings. From all accounts the arrangement worked very well.

## Summary

It would be advisable for schools who have not already done so to develop a standard construction contract for their own use.

The architect, owner, and contractor all have responsibilities, and the way they cooperate will help determine the success of the project.

Surety bonds are used by schools in their construction work. The performance bond and the labor and materials bond are the most important.

Liability insurance and builder's risk insurance are a necessity.

The liquidated-damage clause is a good tool if used properly.

The bonus clause is advisable if a school is so desirous of having a project by a certain date that it is willing to pay a contractor a stipulated sum of money for each day the project is completed in advance of the specified completion date.

A number of matters should be attended to when plans are being finalized, during the period of opening bids, when awarding the contract, and as a new construction project is getting started. Several of these items have been listed and briefly discussed.

# 8

# During Construction

**Inspection and Supervision.** The architect's services during construction might include regular supervision, limited supervision, consulting services, or no services at all. Regular supervision makes the architect responsible for almost everything, including the approval of monthly estimates for payment, change orders, clerk of the works, inspections, and whatever else is required to properly administer the job and keep it running smoothly. For this service, the architect is normally paid 1 1/2 to 3 percent of the contract amount, depending on the size of the project and the amount of his basic architectural fee. Under this arrangement, the architect is definitely the owner's representative and he relieves the owner of much responsibility as well as the necessity of providing an organization to handle the paperwork and most of the on-the-job inspections. "The day by day detail inspections during construction are the responsibility of the architect and/or engineer. On the larger jobs, the architect and/or engineer employs a "Clerk of the Works" who supervises all inspection. The architect and/or engineer is reimbursed for this work in accordance with his contract."[1] This is the type of service most architects would prefer. They feel that a job cannot be done correctly without their supervision and that this arrangement gives them better control. But it has been proven many times that this is not necessarily so. Any good, professionally staffed school planning office whose personnel have worked with the architect closely all through the planning stages is perfectly capable of administering a project and of performing the necessary inspection work. Any Physical Plant Department that has the responsibility for supervising construction and that is properly and adequately staffed can do all that is required and do it well. "The Department of Physical Planning provides full-time inspectors on all major projects (and part-time inspectors on minor projects). Also, the Physical Plant Department makes periodic inspection visits and reviews progress and changes."[2]

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[1] Kenneth J. Hollett, Director of University Physical Planning, University of South Florida, Response to Author's Questionnaire on Planning and Construction, 1975.

"Physical Plant does the detailed building inspections generally by a Resident Engineer *hired, paid,* and *reporting* to the Director of Physical Plant, his Assistant, or one of the Buildings and Grounds Department staff members. Specific parts of a project such as the mechanical or electrical work may also have separate periodic checks by a particular specialist on the Buildings and Grounds Department staff."[3] Certainly, the architect should come on the job, and any good architect would have enough interest in the project to want to. Also, if it became necessary for the architect to render services over and above that specified in his contract, the owner should be willing to pay for it.

*On large projects, say $2 million to $10 million, the university would provide daily inspection with resident clerks-of-works, plus electrical and mechanical inspectors augmenting consultants' minimal provision under their contract. On a $10 million building or a complex engineering project, an additional fee would be paid for resident supervision provided by the consultant and augmented by university staff for continuity and coordination with other projects.*[4]

Some state schools have their construction work inspected by a state agency as well as by their own personnel and their architects and engineers.

*Our architect engineer agreements require minimal of a weekly visit during the course of construction by an architectural or engineering representative. We have a full-time resident inspector responsible to the Director of Administrative Services in addition to inspections performed by the Colorado Divi-*

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[2] James A. Ward, Director of Physical Planning and University Architect, Duke University, Response to Author's Questionnaire on Planning and Construction, 1975.

[3] Peter P. Welanetz, Director of Physical Plant, Williams College, Response to Author's Questionnaire on Planning and Construction, 1975.

[4] John K. Armour, Director of Physical Plant, York University, Ontario, Canada, Response to Author's Questionnaire on Planning and Construction, 1975.

*sion of Public Works and the Colorado Division of Labor.*

*We approach construction as a team effort. The Physical Plant personnel are used as interim inspectors mainly to familiarize them with the systems as they are being constructed. They do not have any real corrective authority. All communications between the contractor, the architect, and the college must go through the office of the Director of Administrative Services.*[5]

"Architect/engineer is responsible for inspections on major projects. We have, until recently, had the clerk-of-the-works furnished by architects on major projects over about 1.5 million dollars. State building commission inspectors make periodic inspections about once a month. Physical Plant Department monitors construction on periodic basis and cooperates with architects and the building commission."[6]

Limited supervision relieves the architect of much of the responsibility during construction other than a minimum, or perhaps a specified number, of visits to the job site. He would still be responsible for checking and approving shop drawings, approving change orders, selecting colors, textures, and finishes, for interpreting plans, and for other services essential to the proper execution of his work. He would not provide the clerk-of-the-works, and he would not prepare change orders; but he would be consulted, and he could initiate those change orders. Certainly he would approve them before they became official. It would be the school's responsibility to see that the job ran smoothly, to provide all the necessary day-by-day inspections, and to handle all the paperwork. All this would require that the school be staffed with an engineer and office help and with building inspectors as needed. Such a system throws considerable responsibility on the school; but where a lot of construction work is being done, there is much to recommend the system.

Under consulting services, the architect would normally furnish interpretations of his contract documents and would review and approve change orders that alter the function, quality, appearance, or cost of the project. Any other services that the school requested—except, of course, those previously agreed to—would be paid for by the school.

Whichever system is used, the important thing is to have knowledgeable inspectors on the job every hour that the contractor or his subcontractors work. Otherwise, on a sizable job, with so many trades at work at the same time, things that do not meet plan requirements can and will be installed and

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5. Wayne McMurtry, Director of Administrative Services, University of Southern Colorado, Response to Author's Questionnaire on Planning and Construction, 1975.

6. John W. White, Director of Physical Plant, University of Mississippi, Response to Author's Questionnaire on Planning and Construction, 1975.

covered up. For example, the specifications might call for four coats of paint, but often it is extremely difficult to know whether two, three, or four coats have been applied. And similar things can happen with any other trade and at any point during construction. This is where the school can utilize specialists from its Physical Plant Department. As the job progresses, a man thoroughly acquainted with air conditioning might be needed to help a regular full-time building inspector for a few hours. The same might be true of personnel from the plumbing, electrical, painting, or other Physical Plant shops.

**Physical Plant Maintenance Personnel.** The college or university building of a few years back was a fairly simple structure as compared with present-day ones. A modern academic building is chock full of electrical and mechanical equipment of all kinds. When a person not familiar with such systems sees the intricate network of wires, switches, transformers, motors, pumps, relays, panels, ducts, chillers, condensers, pipes, filters, conduits, meters, valves, and scores of other electrical and mechanical marvels, his first comment is, "How can anyone put it all together in the first place; and, in the second place, how can anyone know how to operate it?"

Such systems require highly trained and experienced engineers to design them in such detail that components can be ordered and installed or fabricated on the job by highly skilled mechanics and technicians of many trades. How well the designers do their work and how well the construction forces do theirs will determine how well all the highly specialized equipment will perform when it is finally accepted by the school and turned over to the Physical Plant personnel to operate and maintain.

Such equipment is not only extremely complicated; it is extremely expensive. Therefore, it is in the school's interest to see that it is properly designed, properly installed, and properly maintained and operated.

To be sure that it is properly designed, the school should insist that its architect select the best mechanical and electrical engineers available to help him design the project. All plans developed by the architect and the engineers should be carefully checked and critiqued by those persons in Physical Plant who will eventually have the responsibility of keeping the installed equipment and systems operational. Not only will their comments and constructive criticisms help the design engineers, but this will be the first step in familiarizing maintenance personnel with the equipment for which they will later be responsible.

During construction, the project inspector should involve future maintenance and operating personnel in the inspection of the mechanical and electrical systems as they are being installed. This should not be done on a full-time basis, because the maintenance people in Physical Plant have their regular jobs to do and are not available to do full-time inspection work. However, a few hours spent at the right times during construction will not only insure a better construction job, but will also enable the Physical Plant personnel to become acquainted with the intricacies of the complicated gadgetry that will soon be their responsibility. By getting acquainted with the mechanics doing the installation work, and by talking "shop" with them, the maintenance people will pick up many useful bits of information that will be of great value to them at a later date.

It is not fair to expect the technicians in Physical Plant to operate and maintain expensive and complicated mechanical and electrical systems without some prior knowledge of how the systems were designed and constructed. Thus, the training of operating and maintenance personnel should begin during the design stages and then continue through the construction stage and on into the start-up period of the equipment.

Operating and maintenance manuals and parts catalogues should be distributed to the operating personnel as soon as possible, so that such personnel can start getting acquainted with their forthcoming responsibilities. No one would be allowed to operate even a small airplane without several hours of preflight training. And yet a sizable modern academic building may contain more electrical and mechanical equipment than even a good-sized plane. If such equipment isn't understood, operated, and maintained correctly, it can be more expensive than a damaged plane and sometimes just as dangerous.

One word of caution: school personnel should not become so concerned with administering the project that they forget the architect. He designed the project and certified the plans and specifications as a licensed, practicing architect; in that sense it is his project. Any problems relating to design, structural matters, interpretations of plans and specifications, aesthetics, and related architectural or engineering questions should immediately be taken up with the architect. He should be reimbursed for such services rendered. The architect and his engineers should definitely be members of the final inspection team.

Even though there may be several inspectors on a large project, at one time or another it is advisable to appoint one of the most capable and experienced men to serve as chief project inspector or as clerk of the works. He is contact man between the construction superintendent and the school's representative. His is not an easy job: he is expected to be everywhere at once and to know everything at all times. Obviously no one man can do that, but it is his duty to try.

When there are good feelings and mutual respect betwen the superintendent of construction and the project inspector and his assistants, the project will run more smoothly. When the relationship is poor, the superintendent can find many ways to circumvent the inspector, and the inspector can find many ways to annoy the superintendent.

The project inspector's responsibility is to see that the project is constructed according to plans and specifications; it is *not* to approve changes and substitutions. If there are errors or omissions in the plans, it is his duty to report them through channels to the architect so that the architect can interpret or correct them. If the contractor or a subcontractor is attempting to substitute something without proper approval, it is the project inspector's duty to let the superintendent of construction know that he is aware of their intent and that he will inform the owner's representative and the architect. He should do so immediately, not by letter (that is too slow), but by telephone or by a personal visit if necessary. The project inspector should keep a daily log of all important conditions, including weather, soil, and work of subcontractors, and this should be reviewed at the weekly meetings held with the architect and the contractor. (See an example of a daily inspection report in Appendix C.)

An inspector should account for the materials on the job site or in a warehouse. It is possible for materials to be delivered to a job and later removed and used elsewhere. If this happens, the materials on hand might be insufficient to finish the project. And even if the material is replaced, it may not be of the same type, color, or form as the original material. This is especially important with brick, because brick burned from a different pit, or even from the same pit at a different time, will most likely have a different texture and color. It is important to the architect that the brick he originally approved be used throughout the project.

It is important that the project inspector or clerk of the works keep an accurate record of materials, because the school will pay for all or most of the material on the site at any one time, and it is possible for a contractor to claim that he has more material on the site than actually exists.

A good project inspector will know construction methods and practices, and he will familiarize himself completely with the plans and specifications for his project. The superintendent, who is a construction man, will have little respect for a political appointee or someone's brother-in-law who does not understand the plans and does not know his way around the construction site. For the good of the project, it is important that these two key men at least respect one another. Because the project inspector may say "no" many times during the project, he should have enough tact and sense of good public relations to do so without incurring the wrath of the construction forces with whom he works. In short, the project inspector is a key man on the project, and he should be carefully selected for his experience and ability to represent the interests of the school and the architect fairly and honestly.

Occasionally an architect may feel that the school does not trust him when the school elects to do the administrative and inspection work with its own personnel. But he should not, because, as has been mentioned, the entire concept of a smooth-running job is built on trust and cooperation. If the school administrators did not trust the architect, they would not have hired him in the first place. Usually the school chooses to have its own representative on the project because the owner feels that his own professional and technical staff could better represent the owner's interests than could total strangers selected by the architect. If the school does not have such a staff, the only wise thing to do is to pay the architect to represent the owner throughout the construction and acceptance phases of the project.

In the final analysis, it is the school's money that is being spent; it is school personnel who will use any major project constructed for the next fifty to one hundred years. It is school personnel who will spend school money, and a lot of it, maintaining the projects over the span of years. So who has more interest in seeing that everything is done well than the administration and staff of the school?

The method that a school adopts to insure the best possible results should be determined by that school on the basis of its ability to administer construction projects with its own staff and with help from the architect and his engineers. Perhaps the project can better be administered by the architect with help from the school staff. Both methods, with variations, are in use. Certainly the school should decide for itself what is best for its own good and should avoid being unduly influenced by outside forces.

**Further Duties of the Architect.** The architect must see that the project is built in conformity with the contract documents, but he has no responsibility for directing the work of craftsmen on the job, or for giving instructions and directions to subcontractors. The responsibility for determining how the project is produced rests with the contractor and his superintendent of construction. The architect's work should be done through the owner's representative and the construction superintendent. If he feels that there is some portion of the work that could be handled better another way than that in which the workmen are performing it, he should discuss the matter with the superintendent of construction or with the contractor. But the final responsibility rests with the contractor. The architect is the judge of the product, not of the method of production.

The architect must give constant attention to questions that arise from conflicts between parts of the contract documents. No matter how carefully plans and specifications are checked at all stages of their development, discrepancies are bound to show up during construction. Avoiding them does not seem possible. An item shown on the drawing may be specified differently. The detailed drawings may not conform to each other, or conflicting dimensions may be shown. When such discrepancies are discovered, the contractor must have an answer. The meaning and intent of the drawings must be determined quickly. It is the architect's responsibility to render the decisions, and he must be in contact with the project closely enough to be able to make the right decisions.

The architect and the project inspector should review carefully the work being done. Unsatisfactory work should be speedily called to the attention of the construction superintendent. Often the contractor will have to remove portions of unsatisfactory work and replace it; thus, he has the right to expect that any unsatisfactory work will be called to his attention while corrections can still be made expeditiously and economically.

Frequently the architect must furnish the contractor with in-construction drawings that interpret a portion of the project in greater detail. Very often the regular drawings (at 1/8" scale, or even 1/4" scale), are not sufficiently clear to give the contractor an adequate concept of the work he is to do. Then it becomes the responsibility of the architect to provide the contractor with sketches or drawings at larger scale so that the concept can be understood. Occasionally, there is a need for full-sized drawings. They are often required for the hanging of special doors, or for windows requiring special forms of construction. Full-sized drawings are also used in connection with some mechanical work and equipment demanding greater detail. Ornamental ironwork, such as gates and screens, requires carefully prepared full-sized drawings so that the craftsmen will know what the architect wants.

**Shop Drawings.** One aspect of construction can create serious problems—the submission and processing of shop drawings. Shop drawings are prepared by the various trades and crafts to show what is to be furnished and how it is to be installed. If they are not properly prepared or submitted well in advance of their actual need, or if the architect or his engineers unnecessarily delay approving them, the project is liable to be delayed. When there is a project delay, it isn't unusual to find the contractor complaining that he can't get approval of his shop drawings. The architect's response may be that he received them only the day before yesterday but is checking them as fast as he can. Most likely, though, he will indicate that the submissions were so poorly prepared that checking them is taking longer than it would have taken if they had been prepared well in the first place. Shop drawings are for the benefit of the contractor, and it is his responsibility to check dimensions and see that what is proposed is in accordance with plans and specifications. The contractor should not take lightly the matter of submitting shop drawings. They are an essential part of his contractual responsibilities. The architect must see that shop drawings are carefully and speedily reviewed and returned to the contractor by the time the project is ready for them. But no matter who is to blame for the delay of shop drawings, the project will only be further obstructed by disputes between the architect and the contractor over shop-drawing submittals. (An example of a shop drawing transmittal form will be found in Appendix C.)

**Material Submittals.** Another item closely associated with shop-drawing submittals is the selection of color schedules, samples of materials of construction, and decor in general. Again, this requires the cooperation of the architect, the contractor, and the owner. The contractor should let the architect know at a very early date what brands and suppliers he proposes to use. The architect should then prepare a presentation for the owner's approval. This presentation should show coordinated samples of all exterior and interior materials, finishes, and colors. For interior finishes, a good method is to paste on heavy cardboard samples of the various items being proposed for rooms or spaces in the building. Representatives of the school and the architect should review the presentation in detail, and changes should be made until all concerned are satisfied. The architect should then let the contractor know of the decisions and supply him with sufficient details to enable him to place orders. If an interior designer is used, the architect as well as the owner should be involved in making the final decisions.

**Change Orders.** Regardless of the size of a project, conditions that arise during construction will probably make it necessary to issue instructions involving changes in the contract documents.

It is essential that all instructions given to the superintendent of construction or to the contractor be in writing. If emergency verbal instructions are issued, they should be confirmed in writing as quickly as possible. By the same token, any communications from the superintendent of construction or the contractor should be confirmed in writing.

When changes made during construction involve a change in the construction contract, it is advisable to use a carefully prepared "change-order form." These change orders, when approved, become an official part of the contract documents. They should be numbered consecutively and should always be kept current. At the end of a project, the owner's representative, the architect, and the contractor should reconcile the change orders with the original construction contract before a final settlement is made. Each change order should be signed by the contractor, the architect, and by a representative of the owner before it is distributed.

Some contractors seem to thrive on change orders. They insist on being reimbursed for every change made, no matter how small or inconsequential. They also tend to put a high markup on such changes. The owner's representative and the architect/engineer should examine all change-order submittals most carefully. If the price or prices submitted seem out of line, they should be returned to the contractor with the requirement that he lower his price or substantiate his original submittal. Other contractors despise change orders as much as the owner and will do all possible to avoid them.

"Change orders, of course, are the bane of a contractor's as well as the owner's, existence. And I firmly believe that nobody wins on a change. I know some of them are necessary, but to me they represent ignorance on the part of the owner or the architect or the contractor. They should be held to an absolute minimum, and every one of them should be scrutinized with extreme care."[7]

If there is any question about how involved change-order procedure can get, let Ken S. Hayter, director of Physical Plant (now retired) at South Dakota State University explain:

*Change orders are, of course, a dirty word; and our procedure is quite involved. Generally, the procedure is as follows:*

*A. Director of Physical Plant initiates request for change by letter to the Commissioner of Higher Education (On structural changes, the architect/ engineer may initiate).*

*B. Commissioner of Higher Education directs the State Engineer to proceed with change order.*

*C. The State Engineer directs the architect or engineer to obtain a proposal.*

*D. The architect or engineer obtains proposal and if questionable, submits to the State Engineer for a review*

*E. The State Engineer either approves or directs the architect or engineer to negotiate a better price.*

*F. The architect or engineer prepares change orders, obtains contractor's signature. The architect/engineer signs and routes forms for signatures for the Director of Physical Plant, the Commissioner of Education, and the State Engineer.*

*G. The State Engineer sends copy of the approved change order to the contractor.*

*This process may take several weeks and often bogs down the process. We have found it necessary to keep a log of all communications on each change order, and a follow-up is necessary to keep them moving. When time will not*

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[7] John C. Sanderson, Jr., Director of Plant Properties, Northwestern University, Response to Author's Questionnaire on Planning and Construction, 1975.

*permit the above procedure, the State Engineer will usually give verbal approval to proceed.*[8]

**Job Instructions.** Instructions issued during construction that do not involve a change in contract amount or in the scope of the project could properly be issued on a "job instruction form." Instructions could be issued by memo or by letter, but it is easier to file and keep them in an orderly way when they are on a standard form. If a change order incorporates information contained on a job instruction form, the job instruction should be referenced on the change order. The job instruction form is used to transmit information or to request prices on proposed or contemplated changes. It can be used to authorize a contractor to do work without waiting for a change order. It sometimes requires a considerable time for a contractor to get all the information necessary to execute a change order. If a job instruction is issued as an emergency measure to keep the project moving, it should be reissued as a change order as soon as possible. Generally the project engineer or the clerk of the works would sign the job instruction after clearing by telephone, or in person, with the owner's representative.

Each school will probably have its own method of accounting for changes made during construction, but examples of change order and job instruction forms that have proven adequate are shown in Appendix C.

**Storage of Materials.** Often material and equipment is delivered to the job site weeks and even months before it will be needed. Storage can become quite a problem. The contractor will expect the school to pay for such material and equipment. Thus, it is important to all concerned that such material and equipment be properly stored and protected. Frequently, storage space at the job site is so limited that other arrangements for storage must be made. It is wise to have a section in the general conditions pertaining to storage.

The following are items that should be considered:

*1. Arrange and maintain materials in an orderly manner with use of walks, drives, roads, entrances; and keep them unencumbered.*

*2. Provide and maintain on premises where directed, water-tight storage shed or sheds, for storage of materials which may be damaged by weather. Provide such sheds with wood floors, raised above ground.*

*3. Allot space to subcontractors for storage of their materials and for erection of their sheds and tool houses.*

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[8] Ken S. Hayter, Director of Physical Plant (retired), South Dakota State University, Response to Author's Questionnaire on Planning and Construction, 1975.

*4. Confine storage of materials to spaces designated.*

*5. Should it be necessary at any time to move materials, sheds, storage platforms, move same as and when directed without extra cost to Owner.*

*6. Store cement, lime, and other materials affected by moisture on platforms, and protect them from the weather.*

*7. Material or equipment kept in a warehouse must be kept in a bonded warehouse or storage facility.*[9]

**Monthly Progress Estimates.** Each contractor should be required to submit a monthly progress estimate. This is the contractor's request for payment. It is highly desirable that schools have a standard form for such requests. A monthly progress estimate should indicate the total amount of the contract, the amount of previous payments, and the amount of money currently being requested. It should also show the amounts due each subcontractor. It should show the estimated value of materials delivered but not installed since the last payment. All monthly payments would be made less the percentage amount withheld to insure completion of the project. The amount withheld might vary from 2 1/2 percent to as much as 15 percent. After a project has reached a certain stage of completion—perhaps 50 percent—the detained percentage might be reduced or discontinued entirely.

It is especially important to check the amount claimed for materials on the job. This is sometimes difficult, but if a contractor is allowed to receive payments each month in excess of the amount actually due him, it could create a serious problem. During the first half of the construction, he might spend money that should be available during the second half. If the contractor has limited finances, the school could suddenly discover that the contractor does not have funds to meet his obligations as they become due. Any such problems will eventually involve the school. To prevent this, the school should be very strict in seeing that monthly requests for payment are not padded and that the contractor is paying his subcontractors and material suppliers as such payments become due.

The monthly progress estimate document is of the greatest importance to the contractor and to the school. It should be prepared carefully, and the school should make no payment to the contractors until each monthly progress estimate is submitted properly and completely. (Examples of monthly progress estimate forms are included in Appendix C.)

The following is an example of a contractor's breakdown of his anticipated construction costs. A breakdown similar to this should be submitted when the contract is signed or as soon thereafter as possible. The contractor should repeat this same information on each of his monthly progress estimates. In each progress estimate he should also indicate what percent of each item is included and what percent of each item is complete as of the submittal dates. The school's representative should use the breakdown as a control sheet to determine each month if the contractor is including everything that he should. Also, the chief inspector will want to check to see that the percentages listed are reasonably accurate.

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[9] Standard Contract Requirements, Brigham Young University.

### Construction Cost Breakdown*

Project Name ____________
Project No. ____________
Date of Contract ____________

____________
Name of School

____________
Address

Contractor's Name ____________
Contractor's Address ____________
____________

____________
City State Zip Code

| Item No. | Item | Amount | Percent of Total |
|---|---|---|---|
| 1. | General Conditions | $ 120,421.00 | 3.03 |
| 2. | Earthwork | 106,985.00 | 2.70 |
| 3. | Cast-in-Place Concrete | 744,816.00 | 18.80 |
| 4. | Metal Pan System | 61,950.00 | 1.56 |
| 5. | Precast Stone | 326,333.00 | 8.24 |
| 6. | Masonry | 386,400.00 | 9.75 |
| 7. | Reinforcing | 202,075.00 | 5.10 |
| 8. | Structural and Miscellaneous Metals | 130,115.00 | 3.28 |
| 9. | Rough Carpentry | 30,982.00 | .78 |
| 10. | Millwork | 130,682.00 | 3.30 |
| 11. | Waterproofing, Roofing, Roof Insulation | 35,088.00 | .89 |
| 12. | Building Insulation | 2,100.00 | .05 |
| 13. | Sheetmetal | 3,150.00 | .08 |
| 14. | Roof Hatches | 2,100.00 | .05 |
| 15. | Caulking and Sealing | 3,150.00 | .08 |
| 16. | Steel Doors and Frames | 30,300.00 | .76 |
| 17. | Aluminum Entrances, Window Wall, Glazing | 134,400.00 | 3.39 |
| 18. | Special Doors, Rollup | 2,565.00 | .07 |
| 19. | Finish Hardware | 27,465.00 | .69 |
| 20. | Lathing, Plastering, and Drywall | 88,140.00 | 2.22 |
| 21. | Ceramic & Terrazzo Tile | 25,410.00 | .64 |
| 22. | Acoustic Treatment | 110,500.00 | 2.79 |
| 23. | Resilient Floors | 25,600.00 | .65 |
| 24. | Painting | 26,220.00 | .66 |
| 25. | Retractable Partitions | 10,040.00 | .25 |
| 26. | Toilet Partitions | 3,675.00 | .09 |
| 27. | Chalk, Cork, Bulletin Boards & Tack Strip | 8,350.00 | .21 |
| 28. | Toilet Room Accessories | 1,440.00 | .04 |
| 29. | Mailing Equipment | 1,030.00 | .03 |
| 30. | Expansion Joint Assemblies | 1,760.00 | .04 |
| 31. | Coat Racks | 1,740.00 | .04 |

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* Adapted from a form used at Brigham Young University.

| | | | |
|---|---|---|---|
| 32. | Door Signs & Drape Track | 320.00 | .01 |
| 33. | Post Tensioning | 17,693.00 | .45 |
| 34. | Likon Panels | 41,730.00 | 1.05 |
| 35. | Elevator | 39.900.00 | 1.01 |
| 36. | Mechanical | 654,080.00 | 16.51 |
| 37. | Test Allowance for Heat Balancing | 7,000.00 | .18 |
| 38. | Electrical | 377,020.00 | 9.52 |
| 39. | Bonds and Prepaid Insurance | 39,625.00 | 1.00 |
| Totals | | $3,962,350.00 | 100.00 |

Financial Control. Almost all university and college construction projects operate under a tight budget. It does not require many unexpected or unforeseen contract extras to create financial problems. It is bad enough whenever an approved budget is exceeded, but it is worse if the overruns are not discovered until the end of construction. If a costly extra can be related to the total budget at the time it occurs and is immediately brought to the attention of the proper official, it is much more likely to get a sympathetic treatment than it would six months to two years later. Every school doing any building should devise a system to provide current information at all times on the expenditure of funds. The following is an example of the system used at Brigham Young University:

### Explanation of the Financial Control Sheets for X Building Project

> The Project Financial Control Sheets are a means of keeping track of all monies spent on a project in accordance with the amount of appropriated funds as listed on the "Recapitulation of Construction Costs" sheet. The "Summary of Construction Costs" sheet lists all authorized funds and all contracts and other costs related to the project. They are listed and itemized in the appropriate column, and a total running balance is in the right-hand column. Each expenditure is subtracted from the preceding one.
>
> The ten-column sheet titled "X Building Project Financial Control Sheet—Summary of Construction Cost" is a tool to be used by the school for controlling the expenditures of a project. All items, whether encumbered, paid, or anticipated, are put on this sheet. The last column will show whether the project is within the authorized funds or will exceed the authorized funds when the project is completed.
>
> In addition to the actual costs, all estimated expenses are also added to give a total financial picture of the project at its completion. This "Summary of Construction Costs" has to be updated as many times as necessary because of change orders or unexpected costs to the project.
>
> The "Recapitulation of Construction Costs" sheet lists the appropriations for the various headings as shown under "Item." These columns show the actual cost for each heading where known and an estimated cost where unknown, reflecting any credits or debits to the project cost.
>
> The "Summary of Construction Costs" will help the person who is responsible for constructing a project to know where any deficits occur in the project. It will also give early warning when the project is going into the red. Then either additional appropriations or cuts in the work can be made to keep the project within the total project cost desired.

## X Building Project
## Financial Control Sheet
## Recapitulation of Construction Costs

January 13, 1976

| | Item | Appropriation | Actual Cost | Estimated Cost | Credits | Debits |
|---|---|---|---|---|---|---|
| 1. | Base Bid | $816,000.00 | | | | |
| | (Construction) | | $816,000.00 | | | |
| | (Change Orders) | | 6,254.67 | $ 15,000.00 | | |
| | | | 822,254.67 | 15,000.00 | | $21,254.67 |
| 2. | Architectural Fee | 48,262.50 | | | | |
| | (Extra Plans & Specs) | | 1,075.63 | | | |
| | (Architect's Fee) | | 48,262.50 | | | |
| | | | 49,338.13 | | | 1,075.63 |
| 3. | Site Test | -0- | | | | |
| | (Soil Test) | | 150.60 | | | |
| | (Engineering Costs) | | 901.95 | | | |
| | | | 1,052.55 | | | 1,052.55 |
| 4. | Landscaping and Sprinkling | 1,500.00 | | | | |
| | (Site Preparation) | | 412.54 | | | |
| | (Site Development) | | 465.40 | | | |
| | (Physical Plant Expense) | | 29.36 | | | |
| | (Landscaping) | | | 5,500.00 | | |
| | | | 907.30 | 5,500.00 | | 4,907.30 |
| 5. | Administration and Inspection | 2,500.00 | 1,936.00 | 1,000.00 | | 436.00 |
| 6. | Building Permit | 500.00 | 411.33 | | $ 88.67 | |
| 7. | Insurance | 2,400.00 | 1,224.00 | | 1,176.00 | |
| 8. | Furniture and Equipment | 191,937.50 | | 191.628.04 | 309.46 | |
| 9. | Testing and Balancing | 1,000.00 | | 1,000.00 | | |
| 10. | Extension of Utilities | 25,480.00 | 27,190.00 | | | 1,710.00 |
| | | | | SUBTOTAL | $1,574.13 | $30,436.15 |
| | | | | BALANCE | | $28,862.02 |

During Construction

# X Building Project
# Financial Control Sheet
# Summary of Construction Costs

January 13, 1976

| Item | 1<br>Sales Tax Credit | 2<br>Estimated Expenses | 3<br>Physical Plant Costs | 4<br>Encumbered Costs | 5<br>Misc. Costs | 6<br>Arch. Costs | 7<br>Const. Costs | 8<br>Material Costs | 9<br>Authorized Funds | 10<br>Balance |
|---|---|---|---|---|---|---|---|---|---|---|
| Authorized Funds | | | | | | | | | 1,089,580.00 | 1,089,580.00 |
| Construction Costs | | | | 379,365.34 | | | 436,634.66 | | | 273,580.00 |
| Architectural Fee | | | | 6,767.13 | | 41,495.37 | | | | 225,317.50 |
| Printing Costs (Plans & Specs) | | | | | | 1,075.63 | | | | 224,241.87 |
| Engineering Costs | | | | | 901.95 | | | | | 223,339.92 |
| Soil Test | | | | | 150.60 | | | | | 223,189.32 |
| Site Preparation | | | | | 412.54 | | | | | 222,776.78 |
| Site Development | | | | | 465.40 | | | | | 222,311.38 |
| Administration & Inspection | | 1,000.00 | 1,936.00 | | | | | | | 219,375.38 |
| Building Permit | | | | | 411.33 | | | | | 218,964.05 |
| Physical Plant Expense | | | 29.36 | | | | | | | 218,934.69 |
| Insurance | | | | | 1,224.00 | | | | | 217,710.69 |
| Change Orders 1 through 45 | | | | | 6,254.67 | | | | | 211,456.02 |
| Future Change Orders | | 15,000.00 | | | | | | | | 196,456.02 |
| Future Furniture & Equipment | | 191,628.04 | | | | | | | | 4,827.98 |
| Balancing Mechanical System | | 1,000.00 | | | | | | | | 3,827.98 |
| Landscaping | | 5,500.00 | | | | | | | | - 1,672.02 |
| Extension of Utilities | | | | | | | 16,048.02 | 11,141.98 | | - 28,862.02 |

**School's Representative During Construction.** It is desirable to include in the general conditions of the specifications a section outlining the status and responsibility of the school's representative during construction. The title and responsibilities of the school's appointee will vary from school to school, depending on the organizational structure that each school is operating under. The important thing is that the contractor and everyone else involved know who the school's official representative is and what his responsibilities are. Each school should assure itself that this important matter is adequately covered in the general conditions.

**Architect's Status.** The architect's status during construction will largely depend on the duties outlined in the architectural contract. His duties will probably be closely related to the amount of supervision and administration the school is prepared to give. However, there should be no doubt in anyone's mind as to the architect's responsibilities, and a section in the general conditions of the specifications should make those responsibilities clear.

**Relations of Contractors and Subcontractors.** There should be a section in the general conditions setting forth clearly what the school expects of its contractors and subcontractors. The section might begin with something like the following: "The contractor agrees to bind every subcontractor, and every subcontractor agrees to be bound, by the terms of all contract documents as far as applicable to this project, including the following provisions of this section. . . ."

The provisions would include the items that the contractor agrees with and the items that the subcontractors agree with. Each school that has not already done so would do well to prepare such a section, have it checked by the school's legal counsel, and have it included in all subsequent project specifications.

### Summary

There are several ways to handle inspection and supervision during construction of a project. The method used will depend upon the capabilities of the school staff, the school policy, and to a certain extent on the size and type of the project.

Physical plant personnel should participate as much as is possible, and practical, during the planning and construction stages of a project. By so doing they will be able to contribute much practical knowledge to the architect and his engineers. In addition, they will be better informed and better qualified when it becomes their responsibility to maintain and operate the facility.

Regardless of who does the day-by-day inspection, the architect has duties that he must perform during the entire period of construction.

The prompt and proper handling of shop drawings is essential if a construction project is to proceed smoothly. The contractor, the architect, and the owner's representative must cooperate closely with one another to see that all shop drawings are processed as expeditiously as possible.

Material submittals and approvals also require close cooperation between the contractor, the architect, and the owner. All submittals should be made at the earliest possible date. They should be promptly reviewed, adjusted, and approved.

Change orders seem to be a necessary evil. They should be avoided whenever possible. When one is executed, it becomes an official part of the construction contract and must be treated accordingly. Again, the contractor, the architect, and the owner are involved in the preparation and processing of all change orders.

Instructions involving changes during construction should be given in writing and carefully documented. An appropriate "job instruction form" is a standard and systematic way of doing that.

Keeping track of expenditures as a construction project proceeds is very important. Monthly progress estimates as submitted by the contractor should be carefully analyzed by the owner's representative before they are approved. In addition, some form of control sheet should be developed to enable the owner to know at all times the financial status of a project.

# 9

# Final Inspection and Acceptance

No matter how many problems have been encountered during construction and no matter how long it has taken, there eventually comes a time when the contractor, at least, feels the project is finished. At that point, the contractor will notify the school's representative or the architect that he is ready for a final inspection. If the school's representative and the architect agree that the project is far enough along for an inspection, a time for the inspection is set.

**Inspection Team.** The members of the inspection team will be whoever the architect and the school's representative feel is needed. On some projects, notably at schools with small staffs, the team might consist of only the architect, the superintendent of construction, and the owner's representative. This would certainly be the minimal number for a final inspection team and would not be considered adequate for a sizable project.

Many people at the school will have waited a long time for final inspection; and whether or not certain key individuals would be able to contribute anything to the inspection, it sometimes is good policy to invite them to go along with the inspection team. They will not take up much space, and the technical inspections can go on just as well. These key individuals will be grateful for an early preview of the project and will have a much better appreciation of how hard everyone is working to give them a good project. It is good public relations and might even be classified as good politics.

On large construction projects, it is desirable that the inspection team be broken up into three groups. The first group might contain the architect, the owner's representative, the structural engineer, the contractor, the superintendent of construction, and such representatives of the school as are deemed necessary or desirable. This group would be responsible for inspecting everything except the mechanical and electrical components of the job. The second group could contain the mechanical engineer for the project, the mechanical subcontractor, and selected members of the mechanical staff of the Department of Physical Plant. The mechanical subcontractor would have his subcontractors standing by in case they were needed. The third group would contain the electrical engineer for the project, the electrical subcontractor and his foreman, and selected members of the electrical staff of the Department of Physical Plant.

Of course, this organization of the inspection team might not be followed at some schools for one reason or another. The point is that an inspection team can be large; and if it is large, its efficiency is hampered if it tries to do its work as one group. Whether the team remains small and does its work in one group or splits up into smaller, logical groups as suggested above, careful and detailed statements must be kept on discrepancies and faulty conditions discovered during the inspection.

**Punch Lists.** A secretary or recorder should be appointed for each group, and it becomes his responsibility to note all items that, taken together, will make up the "punch list." At the completion of the inspection, all comments should be turned over to one person, generally the architect or the owner's representative, who will edit them and have them typed and reproduced for distribution to all concerned. This document would then become the official punch list as developed by the inspection team. Members of an inspection team should be certain that any discrepancies or irregularities they discover are understood and noted by the team recorder. The recorder may make written records of all findings as the inspection progresses, or he may use a tape recorder so that all comments can be voice recorded to be transcribed later. Because the contractor and his forces are anxious to get final acceptance of the project and the future users are anxious to move in, it is important that the punch list be typed and distributed as soon as possible after the inspection.

The length of a punch list will depend on how successful the project inspector has been in getting things taken care of during construction, how good a job the contracting forces have done, and how nearly ready the project actually was for a final inspection in the first place. Often the first inspection can be considered only a semifinal inspection. Occasionally more than one semifinal needs to be held before a final inspection can be conducted. Experience has shown that contractors will frequently request a final before the project is ready for one. Perhaps they do it on the assumption that they will not have to complete discrepancies not noted by the inspection team. When this happens, inform the contractor that the project is not ready for a final inspection and that he should do his own checking to make sure the project is ready before again asking for a final inspection.

Often a punch list will be many pages in length and will contain such items as: hardware missing, screws missing from hinges, doors not functioning properly, tops of doors not sealed, touch-up painting required, electric outlets not hot in some places, electric switchplates missing, circuits not named in panel boxes, noisy pumps, hot or inoperative motors, etc., etc. It is desirable to have the punch list typed in sections according to the crafts or trades involved. Then the construction superintendent can hand the mechanical foreman his list, the electrical foreman his list, the paint subcontractor his list, and so on. When the construction superintendent does not have to break the list down, he can get all his subcontractors busy immediately. Often a good construction superintendent will have many items attended to by the time he receives the punch list.

The final inspection should not be rushed. It is too important for that. A building cannot be said to be completed until the architect, his engineers, and the school's representative are satisfied that all parts of the contract documents have been satisfied. At this stage of construction, the contractor's tendency is to say, "Let's hurry and get out," and the school's is to say, "Let's hurry and get in." Both tendencies should be discouraged, because the two or three additional weeks spent in "catching up" a multitude of minor items, and a few major ones, could make a great deal of difference to the school in future operating and maintenance costs. Checking some items takes a considerable time. Consider this example:

*With the provision of cooling in recent years, the system for distribution of air throughout the building has become a source of great concern. Air movement with its noises can, in many cases, become very annoying. The proper distribution and balancing of the air movement is critical in many areas. A vital part of the final inspection is the checking of this air movement. The system must be in operation for a short time to assure that all fans, filters, louvers, etc., are functioning properly, and that the construction dirt and dust has been removed from the system so that the system can be given a careful review by the proper individuals. This process of balancing is a time-consuming part of the final inspection process. In very large installations, a special consulting firm is often retained to perform the balancing function. In some instances, it is necessary that the mechanical contractor be retained on the job for some time for the completion of the balance of the work to* *assure that the balancing process is fully complete. This is particularly true when a project is completed during the winter months. It may become necessary to withhold final payment until the summer months, when the normal air temperatures are sufficiently high to give an accurate and positive test of the cooling system. This involves, in particular, the controls subcontractors, and often the electrical subcontractors as well."*[1]

After the punch list has been typed and given to the superintendent of construction, the project inspector and his assistants, if any, should stay on the job continuously checking off items on the punch list as they are satisfactorily taken care of. When all items have been checked off, it is a good idea for the architect and the school people to go over the project one more time. If everything is in order, a letter of acceptance can be written to the contractor. It is customary for a one-year guarantee of materials and workmanship to begin from the date shown on the letter of acceptance. (See a final acceptance statement in Appendix C.)

As stated above, it is not always possible to check everything off the punch list within a reasonable length of time. Often some item, such as a pump or a motor, must be replaced. It might take several weeks to get delivery and effect installation. When such situations occur and the project can be operated satisfactorily in the meantime, the expedient thing is to get a letter from the contractor acknowledging his responsibility for the item, or items, and his willingness to take care of them as quickly as possible. With this assurance, assuming all other items on the punch list have been checked off, the owner can occupy and start using the facility. The school is further protected by the fact that it is still holding sufficient contract funds to insure satisfactory completion of delayed items. Final and complete settlement should not be made until everything is satisfactorily completed in accordance with the contract document. (See a "substantial completion acceptance of project" memo, Appendix C.)

"If the final punch list shows an item or items which cannot be completed for a considerable time, but the value is not sufficiently large to delay final payment on the full project, it is possible to establish with the contractor the amount required to complete such an item. This amount can then be deducted from the final payment certificate to be paid when the item is fully completed."[2]

**Arbitration.** Occasionally a dispute will arise between the contractor and the school over some item. The school may insist something is called for under the terms of the contract, and the contractor may feel very strongly that it is not. In such cases, the school should call upon the architect to interpret his plans and specifications and to state in writing what he considers to be required. If the contractor, the architect, and the school officials still cannot agree and the item in question is of sufficient importance, it might be necessary to form an arbitration board to consider all sides of the question and render a decision as to responsibility. Such action should be avoided if at all possible. Persons of good will can most frequently settle their differences of opinion without resorting to arbitration. However, because the necessity for arbitration is always a possibility, provision for it should be a part of the general conditions of the specifications, and its provisions should be understood by all concerned before the project is started.

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[1] Fred L. Markham, F.A.I.A., Markham and Markham, Architects and Engineers, Provo, Utah, Written Statement to Author, 1975.

[2] Markham, Written Statement to Author, 1975.

**Prerequisites for Final Payment.** There are certain items to which the school should give particular attention before paying the contractor in full.

*Operating and Maintenance Manuals.* It is important that the school's representative receive a complete list of all manuals containing information on the operation and use of equipment—especially mechanical and electrical equipment—installed in the project. These manuals should be bound and indexed and provided in sufficient numbers that all concerned school personnel can have a set. The sets should include the following:

1. Complete description of items, including catalog numbers
2. Complete parts list for each item
3. Name and address of local supplier
4. Name and address of manufacturer
5. Complete operating instructions
6. Complete maintenance instructions

*Keys.* All keys should be properly tagged and turned over to the school's representative. Master keys should be sent directly to the school's representative by registered mail with notice of receipt requested. They should *not* be handed to someone on the job to be delivered to someone else.

*Lien Waivers.* Neither the final payment nor any part of the retained percentage should be paid to the contractor until he has furnished lien waivers, not only from himself, but from all subcontractors and major material suppliers. (See a "contractor's affidavit, waiver of lien and wage" in Appendix C.) The lien waivers should be carefully checked against the list of subcontractors and major material suppliers to insure that all have been received. The purpose is to indemnify the school against any lien. If some waivers are not obtainable, the school might consider requiring the contractor to furnish an acceptable bond as further protection against being served with a lien.

*Bond Release.* Final payment should not be made to the contractor until he has supplied the school with a release from his bonding company authorizing the school to pay the contractor in full.

*Guarantees.* Divisions of the contract documents should be carefully checked to see if any items installed carry a guarantee for more than one year. The general conditions should contain a section on "guarantees" that would normally provide for the contractor to correct any faulty workmanship or materials that occurred within one year of the final acceptance of the project. The section should also have a clause requiring that the contractor be similarly responsible for all items for which a guarantee exists in excess of one year. Everything pertaining to guarantees should be examined—doors, roofing bonds, flashing endorsements, and so on.

> *It is customary to include in the General Conditions the provision that the General Contractor is to guarantee all materials and workmanship on a project for a period of at least one year. Under some special circumstances, this may be extended to two years; in which case, it must be so noted in the General Conditions. This provision, of course, relieves the Contractor of any deficiencies caused by general wear or improper treatment of the building or its constituent parts.*
>
> *In addition to the General Contractor's one year guarantee, various divisions of the contract document should be checked to see if any items installed in the project carry a guarantee for more than one year. If so, special note should be made of them.*[3]

It is important that another very careful inspection be made of the project before the end of the one-year guarantee. It is quite likely that many items that require fixing, replacing, or adjusting can be taken care of under the terms of the guarantee.

"On some projects, we have found it pays to hold a "final-final" inspection about one month before expiration of the one-year warranty. This way, punch list items that have not been corrected are revised, and bugs that will come to light during eleven months of occupancy can be studied and responsibility established."[4]

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[3] Markham, Written Statement to Author, 1975.

[4] Ken S. Hayter, Director of Physical Plant (retired), South Dakota State University, Response to Author's Questionnaire on Planning and Construction, 1975.

*As-Built Drawings.* As-built drawings are especially important. Without them, the Physical Plant personnel will be greatly handicapped in their work of maintaining and operating the facility. During construction, the contractor should have kept one set of drawings on which he entered all changes, both major and minor, that did not conform to the plans and specifications. Upon completion of the project, the contractor should turn over this set of corrected drawings to the architect, who should incorporate all such changes, plus any changes brought about by job instructions or change orders, into the original tracings. The architect should then furnish the school with a complete set of as-built drawings on sepia reproducibles.

*Cash Allowances.* Occasionally the contract documents will provide for a cash allowance of so many dollars. This is generally to pay for some item or items that might or might not be needed; but if needed, the cost would be hard to determine in advance. As an example, the soil condition under a building might be so poor that a final foundation determination could not be made until the excavations were completed. In such a case, a cash allowance of, say, $30,000 could be specified to cover any additional work that might be required. After the work is done and a final cost is determined, it might be that the additional work amounted to $23,000. As the cash allowance of $30,000 was included in the contractor's base bid, the change order would be prepared reducing his contractual amount by $7,000. Had the work cost $37,000, a change order would have been issued to the contractor increasing his contractual amount by $7,000, the overrun to be covered in some way by the school.

This sounds simple enough, but it is easy to overlook a cash allowance settlement at the end of a project. It could be that an auditor would be the first to discover it. A wise provision on cash allowances is to include a statement in the Form of Proposal that a cash allowance of so many dollars is called for under Section ____ of the specifications. This will at least insure that the contractor will not overlook it in preparing his bid. If the paper work is kept up to date during construction, the final settlement will be easier, and fewer disagreements will occur.

*Contractual Completion Date.* The contractual completion date, including extensions, should be checked. If the job was not finished within the agreed length of time, including any extensions granted, the owner and the contractor must have a serious talk. Liquidated damages may be involved. Of course, the contractor will do all that he can to avoid paying them. There are some things for which a contractor can legitimately claim extensions that make it difficult to collect liquidated damages. It is a good policy to include in the general conditions a statement that any claim for an extension must be made in writing within ten days after the alleged need for such an extension is known. Such requests should be promptly considered by the school and either accepted or rejected. If accepted, the contractual completion date would be officially extended in writing by the additional days granted. It is not a good idea to wait until the project is finished and then try to settle several requests for extensions. Occasionally a request for an extension of a completion date becomes so critical that the president of the school has to decide whether or not to grant it. One thing is almost certain: on any sizable project, something will happen to cause the contractor to want an extension of his contractual completion date. Handle each request as it is made, and keep the paperwork up to date.

*Job Instructions and Change Orders.* During construction, no changes from the contract documents should have been made except those changes properly authorized in writing. The school's representative or the architect/engineer should send the contractor such instructions on a job instruction form or on a change-order form. The contractor should know, from a section in the general conditions of the specifications, that payment is not made for work done unless such work is authorized in writing. Thus, care should be exercised during construction to see that all job instructions and change orders are properly executed and promptly processed. At the end of a job, when final settlement is being made with the contractor, these documents become very important. All change orders should be reviewed and their effect on the original construction contract agreed upon by all concerned before final payment is made. If the paperwork has been handled efficiently during construction and if each change or variation from the contract document has been priced and agreed on, the final settlement will not be difficult. If too many controversial matters have been allowed to accumulate, the final settlement could be troublesome. Adequate forms and their proper use will do much to make the business side of a construction project more efficient.

**Occupancy Before Completion.** Quite often a portion of a building still under construction will be finished and available for occupancy before other parts of the building are ready. It is wise to have a section in the general conditions of the specifications that would permit the school to occupy a portion while work continued. This can be useful when the job is lagging behind the contractual completion date and certain departments or functions need to get located so that their vacated space can be modified for new occupants. (A new building nearly always sets up a chain reaction.) Also, furniture and equipment will be arriving and it is better and more economical to put it in the building than to store it elsewhere and have to move it again. However, people should not be moved into a new building unless it is a real emergency. Premature occupancy can cause the contractor and his subcontractors real problems and might even affect their insurance. However, if the emergency is great enough to justify the risks involved, it is good to have provided for early occupancy when the specifications were being prepared. Occupancy of the building, no matter how limited it might be, before final acceptance should be made only with the full concurrence and cooperation of the general contractor.

**Inspection.** It should be clearly stated in the general conditions of the specifications that the school will have inspectors to inspect the work as it progresses. It should also be clearly stated that having such inspectors on the job does not in any way relieve the contractors of responsibility for performing in strict accordance with the contract and with the contract documents.

**Final Acceptance.** It may require a number of sessions with the contractor of a sizable project before mutual agreement can be reached; but when everything is in order, the contractor should submit his final progress estimate. This should be carefully checked by both the school's representative and the architect. If everything is in order, final payment can be made and a letter of acceptance written. The one-year guarantee of workmanship and materials will begin from the date on the letter of acceptance. Each school will have its own method of notifying the contractor and others concerned that a project is acceptable. The following letter states about all that needs to be said in a letter of acceptance:

6 August 1976

(Name and Address of Contractor)

Re: *Acceptance of Contract*
(Name of Project)
(Number of Project)
(Date of Contract)

Gentlemen:

This letter is your notification of __(Name of College)__ formal acceptance of the completion of your contract for the __(Name of Project)__ at the __(Name and Location of College)__ as of __(date)__.

The foregoing date commences the one-year guarantee of workmanship and materials.

Yours very truly,

SFB:rlj

cc: President
Owner's representative
Architect
Building inspector
Legal Department

**Summary**

Composition of the final inspection team is important. The punch list should be carefully prepared listing all discrepancies, omissions, shortages, unacceptable workmanship, etc., discovered during the final inspection. The punch list should be typed and delivered to the superintendent of construction as quickly as possible.

The contractor should deliver to the school all operating and maintenance manuals, keys, lien waivers, bond releases, guarantees, etc. The contractor should deliver to the architect marked plans showing all changes from the contract documents that were made during construction. The architect should correct his documents and deliver a set of as-built drawings to the school. The contractor, the school's representative, and the architect should reconcile all business transactions before final payment is made to the contractor.

When the project is acceptable to the school and all financial matters have been agreed to, the school can write the contractor a letter of acceptance; the one-year guarantee of workmanship and materials will start from the date of the letter.

# Part 3: Allied Subjects

# 10

# First Cost of a Building versus Its Maintenance Cost

This is a subject about which it is sometimes easier to generalize than to produce facts. Because colleges and universities have not been required to show a profit, they have been slower to keep records and to make studies aimed at reducing operating and maintenance costs than have building owners and managers in private industry. Everyone is aware that maintenance and operation is expensive. It isn't unusual to have a business manager, president, or board member ask what it will cost to maintain a building, over a span of years, in comparison to its original cost. Answers may range from twice as much to several times as much. But so many factors are involved that it would require considerable time and research to produce a factual answer.

A great deal of information is available on the operation and maintenance of commercial buildings. The owner of a high-rise office building that is built largely on borrowed money must be able to determine fairly accurately in advance, not only what the project cost will be, but what it will cost to cover all other items, ranging from taxes, interest, and administration to custodial services and utilities, over a span of many years. The margin of profit is generally quite low, and "life-cycle costing" is a matter of prime concern. As a consequence, much good work has been done by the Building Owners and Managers Association, International (BOMA), and by its affiliate members to determine methods of producing better buildings at less cost and of providing high standards of service to their lease holders at the least possible cost.

Any school could profit by a review of the work that has been done, and that is being done, in private office-building construction and management. BOMA has a bimonthly publication, *Skyscraper Management*, that would be of interest and assistance to anyone interested in university and college physical plant work.

There are major differences, however, between commercial building operation and the development and operation of physical facilities at an institution of higher learning. Schools are not required to show a profit on their academic buildings (certain auxiliary and revenue-producing buildings are exceptions). Schools do not normally pay taxes, which is one of the largest, if not *the* largest, single item the private owner has to contend with. Schools can't concentrate on one type of building, but must build all types of highly specialized structures for all kinds of functions and "specialist clients." Campuses often cover large tracts of land with miles of roads and walkways. Because of these and other differences, cost data developed by the business sector cannot be applied straight across the board to the operation of university and college physical facilities.

But quality construction at reasonable cost and operation at less cost should be the goals of all school people, just as they are for the builder or manager of a private high-rise office building in the heart of a busy city. Private industry has not hesitated to turn to colleges and universities for help in making its operations better and more efficient. By the same token, schools could learn a great deal from private industry on how to save time and money in the development, maintenance, and operation of physical facilities.

**First Cost of a Building.** There are few buildings on any college or university campus that could not have been planned more efficiently or constructed more economically. There are probably even fewer that could not have been planned to better reduce maintenance and operational costs. "There is a very direct relationship between the planning of a facility and the resulting operation costs, a relationship not always given the attention it deserves."[1] A number of factors contribute to this situation. But let's start with the school itself. Too many buildings are programmed by committees more concerned with everything being "bigger and better" than with original and long-term costs. Often a school will allow its architects and engineers such a short length of time to prepare plans that they do not have time to investigate and compare competitive items. It is a truism that the highest priced item is not always the best, but it is quite likely that it will have the most convincing literature and the most articulate sales representatives. To build a better building for less money requires that the designers of the structure know about the availability, suitability, and cost of many things. When they do not have sufficient information about an important item, they should have time to investigate.

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[1] Clarence P. Lefler, Director of Physical Plant Division, Ohio University, "Planning and its Effects on Maintenance," Paper given at the Fifty-Ninth Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, University of Cincinnati, 1972.

It is at this point that "what should be" starts losing out. In the first place, the school is in too big a hurry to wait for its building and if faced with the decision to slow down or to speed up would probably say to its architect, "Do the best that you can, but give us the plans as quickly as possible." In the second place, few schools can let architects and engineers specify a single item by brand name even though it is known to be better and less expensive than any like product on the market. If a school could allow its architects and engineers complete freedom to specify the most suitable and economical materials, products, and equipment on the market, to the exclusion of all similar competitive items, it could almost guarantee itself a better building, if not at a lower price. But public relations, politics, and the competitive system will seldom allow it. Competitive bidding does tend to keep prices down, but having to award a contract on the basis of price alone does not always result in more than an initial saving. Over a period of time the cheaper item might cost considerably more for repairs and replacement parts than would a competitive item of higher original cost. Thus, if a school has complete freedom of choice what should it do? Should it plan a building for lower initial cost regardless of its impact on future operational cost, or should it plan a building that might cost somewhat more initially but would definitely be more economical to operate and maintain?

*In designing a building it is obviously necessary to try to satisfy many factors and conditions, some of which are not always compatible. We try to set as the first consideration functional design—a building should fill the needs for which it was intended in an efficient and economical manner. And secondly—we have to think about aesthetics and environment—a building should be pleasant to look at and pleasant to live in and work in. The next consideration should without question be permanence and ease of operation and maintenance. But unfortunately this and the other considerations are often compromised and sometimes almost rooted out entirely by a fourth consideration—budget. The initial cost, it seems, is too often the paramount consideration. If we were to single out just one area where you people in Physical Plant who are concerned with operation and maintenance and where we architects should pull together its probably here. It behooves us* *both to get enough in the construction budget to build a good building—taking into account maintenance along with the other considerations.*[2]

*To plan a building for low initial or construction cost means, of course, that the building must be conceived to employ materials of low purchase price, that such materials must be used in the minimum quantity, and that labor must be reduced to the bare essentials for obtaining a finished structure. Planning for low maintenance cost usually involves a selection of materials upon the basis of wear resistance, durability, ease of cleaning and repair, and general longevity. The two approaches are not always compatible. Often in reducing the initial cost of a building to the limits of a fixed budget, we create future maintenance and repair cost; but we do so knowingly. On the other hand, over-consideration for maintenance costs can result in a initial cost far beyond a budget. There must be and usually is a compromise.*[3]

Even under the best of situations it isn't practical to investigate the relative costs of every item that goes into a building. But it is important to know what components of a building are the most costly and to effect as much savings as is practical in those areas. The electrical and mechanical systems of most university and college buildings represent a large percentage of the total cost, and all plans of those systems should be thoroughly investigated as to both cost and performance. Lighting is one part of the building where much study and thought should be given. Light levels should not be reduced below generally accepted standards, but often it is possible to meet those standards at considerably less than the cost of what was specified. This is an area where the owner should be specific as to his needs and desires and be "hard nosed" in seeing that his requirements are followed.

Stephen W. Call, supervisor of electrical engineering, Building Division, The Church of Jesus Christ of Latter-day Saints, Salt Lake City, Utah, was asked to make a few observations on the important subject of electrical design in saving energy. The following are his comments:

*In past years, appearance was the first consideration in choosing light fixtures. Today the efficiency of the light source should be the first considera-*

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2. W. G. Lyles, Lyles, Bissett and Wolff, Architects-Engineers. Architectural Discussion, Minutes of the Annual Meeting, Southeastern Regional Association of Physical Plant Administrators of Universities and Colleges, University of South Carolina, 1960.

3. Frank Marion Orr, A.I.A., Dean, School of Architecture and the Arts, Alabama Polytechnic Institute. "Planning Buildings for Lower Construction Costs," Paper given at the Fortieth Annual Meeting, Association of Physical Plant Administrators of Universities and Colleges, Alabama Polytechnic Institute (now Auburn University), 1953.

*tion because of the need to reduce the use of electrical energy. The amount of energy used and the cost of maintaining a light fixture can easily exceed the original cost of the fixture in just a few years.*

*There are a number of ways the costs can be reduced through design. The following five should always be given consideration.*

*(1) The higher the voltage used, the less the $I^2R$ loss (line loss) will be on the system. For example, a 277/480-volt system is more efficient than the 120/208-volt system.*

*(2) Use fluorescent lamps in place of incandescent lamps wherever possible.*

*(3) Task (spot) lighting is more economical than general lighting.*

*(4) Rooms painted in light colors require less energy to provide adequate illumination than rooms painted or paneled in dark colors.*

*(5) Provide sectional lighting in large rooms or areas where only a portion may need to be lighted at any one time.*

*The most important thing a professional engineer can do for himself and his client is to challenge his design to the point where he is constantly looking for ways to cut cost, improve efficiency, and reduce errors in his projects.*[4]

Air conditioning is very expensive, both in its original cost and in later operating cost; thus, the amount to be installed and the type and characteristics of equipment available should be determined only after all factors affecting cost have been considered. Because of the expense of heating and cooling and the need for conserving energy, future buildings will likely be designed with much less glass and will be situated to take advantage of seasonal and solar changes. They will be better insulated. And more thermopane, tinted glass, and activated louvers and sunscreens will be used. There is even a good possibility that considerably more building space will be constructed underground than has been done in the past. These factors and many others have a direct bearing on the construction and operating costs of a building.

*There is yet another relationship between planning and operation costs about which we should be cognizant. The operating cost for a facility having a design useful life of 50-100 years can easily surpass the original construction cost several times during its lifetime. This suggests that planning decisions should give as much or more emphasis to the resulting operating cost than to the initial cost.*[5]

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4. Stephen W. Call, Supervisor of Electrical Engineering, Building Division, The Church of Jesus Christ of Latter-day Saints, Written Statement to Author, 1975.

5. Lefler, "Planning and Its Effects on Maintenance."

Energy use and cost can be reduced if the owner really wants to do so and if his architects and engineers are so informed. But waste cannot be reduced by repeating many of the inefficient and wasteful methods of the past. More efficient use of energy is already a matter of prime concern, and it will be of even greater concern long before any building constructed in the seventies is ready for razing or even for a major remodeling. School personnel should be sure that their architects and engineers are capable and up to date on the very latest methods and equipment. Even the best building that can be built at any one period is likely to be obsolete long before it is structurally unsound and functionally inadequate; there is little excuse to start off with an obsolete one.

Custodial services constitute the largest single maintenance expense. Therefore, much thought should be given to the placement of custodial closets, the selection of floor materials and wall surfaces, the accessibility of light fixtures, and similar items that might not seem overly important to the programming committee and to the architect but that could greatly affect future maintenance costs. A plastered and painted corridor wall might be slightly less expensive initially than a tile, brick or glazed block wall, but its daily cleaning and periodic painting would in a very short while offset the early savings. A terrazzo floor in a heavily used foyer or corridor would cost more than vinyl tile, carpeting, or a parquet wooden floor, but it might still be the most economical floor material that could be used. These are just two examples of how the first cost of a building sometimes conflicts with its maintenance cost. But it is equally true that some items that would reduce maintenance and operating costs are no more expensive than other materials having higher maintenance and operating costs. It is here that personnel in the Physical Plant department can be of great help. Most of them can tell architects, engineers, and members of planning committees which materials, equipment, and arrangements make for a better and more economical operation. School administrators should make use of the practical knowledge these people have gained and by so doing save some money.

Often when a reduction in the cost of a building is needed, the first suggestion is to reduce the cost of the exterior surfaces. Then the building generally suffers aesthetically. A careful study should be made to determine just what percentage of the project cost could be made by changing from brick to painted concrete lava or cinder blocks, or from brick and cast stone to some less expensive material. Most often the savings won't justify an outside finish incompatible with that of the most architecturally pleasing buildings on campus. Unattractive buildings should be discouraged everywhere; but on a university or college campus, where the arts are supposed to flourish, they are especially objectionable.

A better answer is that there are many ways to save money and still have an architecturally pleasing, well-constructed building that will be efficient and relatively easy on the maintenance and operation budget. The trick is to want to do it, assemble a team that can do it, and then *do* it.

It is possible that university and college administrators and staffs as a whole have been overly conservative, following old traditions and responding slowly to new solutions for old problems. A few schools, though, have adopted new ideas readily, discarding many stereotyped notions and patterns from the past.

Many future problems will be entirely different from today's. People and products will change as the problems change. New sources of energy, new products, new and strange equipment, new and more stringent regulations are going to necessitate changes in building design and operation. Architects and engineers must develop systems and procedures in tune with the times. College and university personnel must be willing to try, and to adjust to many things that will be different from those of the past.

One can wonder where the first institution of higher learning will be built that is heated primarily by solar heat, where the first major college building will be constructed without windows, where the first large classroom and office building will be developed completely undergound, and when students and staff will park their electrical and hydrogen-propelled vehicles off campus and flit about from building to building by means of some kind of a "gravity resistor" strapped to their backs. Certainly the campus of the future will be different—and perhaps even better. And it is certain that building codes will change, new products will appear, new generations of students, teachers, and staff will be on the campuses. But administrators will still be asking, "What is the cost of maintaining and operating a building compared to its original cost?" Hopefully it will be less.

**Maintenance Cost of a Building.** The time may come when a board of trustees, a state legislature, or a funding body may hesitate to approve a request for a new building unless they can be shown some fairly conclusive information about the cost of operating and maintaining the building over a period of years. And well they might. Many schools with splendid buildings have found how difficult it is to keep coming up with the funds necessary to properly care for them. There is a lot of truth in this old cliche: "It's easier to get money for a new building than to get money for maintaining it."

Deferred maintenance accumulates at an amazing rate. When school budgets are reduced, as they frequently are, it is sometimes expedient to let a building badly in need of painting and other maintenance go for another year, or two, or three. . . . When a new academic program is wanted and money is a problem, the program is sometimes implemented at the expense of the Physical Plant budget. It's easy to get excited over the prospect of a new building. And every university or college president likes to point with justifiable pride to additions to the physical plant that occurred during his administration. But each new building, from the day it is occupied, is another sizable item in the annual budget request. There is nothing more depressing to see than a splendid building of great architectural beauty gradually but inextricably falling into a state of disrepair because the maintenance budget is inadequate. A school administrator should take as much pride and satisfaction in having well-maintained buildings as in having new buildings.

To the casual observer a building might appear to be in perfect condition when in actual fact it is in need of thousands of dollars of work just to bring it back to where it could be adequately and safely operated and maintained. There is no economy in letting a building get into that shape. It is a waste of taxpayers' money. True economy means giving expensive buildings the care they need when they need it.

The question of how much any proposed building will cost to maintain and operate cannot be stated accurately. It is difficult enough to estimate the construction cost of a building after a program of requirements has been prepared—or even after plans have been drawn. But architects, engineers, and campus planners *must* make early estimates of building costs and budgets, and requests for appropriations are often made and submitted on the basis of such estimates. Estimates are arrived at by different methods or combinations of methods. If no plans are available, estimates are made on the basis of experience and by comparing what is known of the proposed building with a similar building already constructed whose cost is known. A square-foot or cubic-foot cost is determined, and that multiplied by the square feet or cubic feet in the proposed building constitutes the base price from which the project cost is determined. If plans are well developed, quantity takeoffs can be made by the architect and his engineers and fairly reliable cost figures can be obtained. There are firms that specialize in making estimates for architects and contractors, and such a firm could be employed by the architect or by the school to prepare the needed cost estimate. Occasionally the architect or the school will get a general contractor to estimate the cost of a project. But none of these methods are infallible, and misses by a "country mile" are not unusual.

If it is difficult to accurately determine in advance what a proposed building will cost, it is much more so to forecast what it will cost to operate and maintain the building over its life span. In the first place there is no way to determine its life span. It might last for 200 years or it might be replaced in 50. Second, much will depend on whether the building is to be planned for low maintenance cost or for low initial cost and with little concern for future costs.

When confronted with such imponderables, certain assumptions must be made: (1) The building will or will not be planned for ease and economy of maintenance and operation. (2) The life span of the building is estimated to be x number of years (say fifty). (3) Increases in maintenance and operating costs, brought on by inflation and the increasing age of the building, must be plotted and projections made.

After such assumptions have been made and agreed upon, the next step is to apply known cost factors. Many schools have accurate and fairly complete data on maintenance and operating costs. For years the Association of Physical Plant Administrators of Universities and Colleges has encouraged its members to share such information so that meaningful norms could be established. However, comparisons between schools and between different sections of the country are seldom sufficient. Such figures are valuable as a means of determining whether projected costs appear to be way out of line or "in the ball park." However, standards of maintenance, labor costs, type and quality of buildings involved, the kind and amount of use the buildings receive, and the efficiency of the responsible organizations can vary so much that even long-range averages may not provide information precise enough to satisfy a president or a budget officer.

Time-and-motion studies have been made on how long it takes a custodian to do x amount of work, and such exacting studies have been made on other phases of physical plant work. That is good, because such studies indicate how efficiently the work is being done, and efficiency as much as anything else determines cost. But what if someone wants a statement on what a proposed new building (100,000 gross square feet, with an estimated $4,200,000 construction cost and a $5,000,000 project cost) will cost to maintain over a period of fifty years? The best thing to do is to try changing the subject. Otherwise it's too easy to get bogged down in a mass of statistical data that only a computer could understand.

However, there is a fairly simple method of obtaining the information required for (1) estimating the needed budget for a new building during its first year of operation and (2) estimating the operation and maintenance cost of a proposed building for a given time. This method of costing is built around the "work order" or "job order" system that all physical plant departments use, or should use. (See an example of a work order in Appendix C.) It involves issuing "standing work orders" at the beginning of each budget year for each building for which maintenance and operating costs are wanted. A standing work order to provide custodial services in a given building will, if properly kept, provide an actual dollar cost that can be stated in one figure. The same may be done for grounds, electrical, water, heat, air conditioning, administrative, and other services that all together constitute the total cost of maintenance and operation work performed for any building during any budget year.

A separate work order should be issued for each service provided. Meters for measuring water, heat, chilled water, electricity, and gas must be available in each building to afford the most accurate information on those services. If there are no meters, the amounts and value of such services for each building must be calculated as accurately as possible. The "work order form" must be designed to secure the type of information wanted, and personnel must be instructed on how the information is to be obtained and recorded. At the end of each budget year a summary should be prepared showing the individual cost of services provided and the total cost of such services. It is obvious that records must be kept for two or three years before their full value can be realized. The longer they are kept, the better the records will be and the more useful they will be in forecasting future costs.

When the budget for a new building is being prepared for the first time, it is wise to select an existing building of similar size and use where records have been kept and to use it as a guide in putting together the budget for the new building. If the services in the building used as a guide have been satisfactory, it will be really hard for anyone to find fault with the proposed budget for a comparable building going on the line for the first time. Without such information, any adroit budget office might be hard to convince that the proposed budget is realistic and not padded. And the truth is that without such factual information the proposed budget could very well be too high. Or it might be too low—and, for lack of documentary evidence, end up being lowered still more.

The following chart is of a hypothetical building of 100,000 gross square feet. It was assumed to have been constructed in 1968 and 1969 at a project cost of $5,000,000. The cost figures given for the various services over the five-year period are also imaginary. The chart is presented only as an example of how records obtained from "standing work orders" can be kept to show annual maintenance costs. The fictitious chart illustrates how the cost per square foot increased from 1970-71 ($.99) to 1974-75 ($1.41). It shows the cost of each service for each of the five years and the variations in cost for each service year by year.

The hypothetical building in the chart cost $1.15 per year per square foot for maintenance, or $5.75 per square foot for the five years. The total cost of maintaining the building for five years would be $5.75 x 100,000 square feet, or $575,000. At the same cost—no increases or decreases—it would cost $5,750,000 to maintain the $5,000,000 building for fifty years. If the costs continued to escalate for fifty years as for the first five-year period (roughly an average of 7 percent per year), the maintenance cost would be astronomical. If the costs were escalated over the fifty years at an annual increase of

## Maintenance Costs for a Hypothetical Building

| Building of 100,000 Square Feet | 70-71 | 71-72 | 72-73 | 73-74 | 74-75 | 5-Year Total | 5-Yr Cost per Ft$^2$ | 1-Yr Cost per Ft$^2$ |
|---|---|---|---|---|---|---|---|---|
| Routine Maintenance* | 9,335 | 9,840 | 10,325 | 11,225 | 13,680 | 54,405 | .544 | .109 |
| Grounds Maintenance | 5,370 | 5,515 | 5,930 | 6,845 | 7,680 | 31,340 | .313 | .063 |
| Custodial | 42,315 | 43,865 | 46,420 | 54,720 | 62,385 | 249,705 | 2.50 | .500 |
| Administration | 5,345 | 5,630 | 6,180 | 6,915 | 7,545 | 31,615 | .316 | .063 |
| Security | 3,680 | 4,005 | 4,640 | 5,335 | 5,920 | 23,580 | .236 | .047 |
| Electric Power | 18,995 | 18,720 | 18,815 | 19,440 | 21,385 | 97,355 | .974 | .195 |
| Water | 2,005 | 2,335 | 2,410 | 2,465 | 2,660 | 11,875 | .119 | .024 |
| Heat and A/C | 11,520 | 12,895 | 14,210 | 16,465 | 19,660 | 74,750 | .748 | .150 |
| Total | 98,565 | 102,805 | 108,930 | 123,410 | 140,915 | 574,625 | 5.750 | 1.150 |
| Cost per Ft.$^2$ Per Year | .99 | 1.03 | 1.09 | 1.23 | 1.41 | 5.750 | | |

*All minor, routine repairs by Carpenter, Paint, Mechanical, Air-Conditioning, and Electrical shops

3.5 percent, the maintenance cost for the building would be approximately $12,900,000.

Those figures illustrate why no projection made too far into the future can ever be accurate, for who can tell what the state of the economy will be in ten years—much less in fifty years? However, actual yearly and accumulated yearly records of maintenance cost for campus buildings are useful and, even when projected into the future, are certainly more dependable and persuasive than any unsupported guesses would be. A realistic estimate based on factual information and reasonable projections is all that anyone should be expected to provide.

It should be recognized, however, that whether inflation continues or not, maintenance costs will continue to increase, because as a building gets older more care is needed to keep it in first-class condition.

## Summary

It isn't unusual to have an official ask what it will cost to maintain a building over a span of years. This is a good question. Maintenance and operation is expensive. Each time a new building is put into use, the annual operating budget must be substantially increased. And the operating budget for a building will continue to increase as the building ages.

When buildings are being planned, their future operating cost should be considered carefully. It is possible to plan and construct buildings so as to reduce future costs. To do so requires that the designers be cooperative and concerned about such costs. The school staff must also cooperate on many things, including allowing the designers sufficient time to do a thorough job of researching the availability, suitability, and cost of all items on which savings might be effected.

Buildings should be planned to take advantage of every means of conserving energy. Custodial care constitutes one of the big costs. Materials should be used that will reduce those costs.

It is difficult to determine in advance what a proposed building will cost in maintenance and in operation. A school that has kept careful data on the cost of its buildings will be able to estimate fairly accurately the future costs of proposed buildings. Schools that have not kept accurate records should begin to do so.

There are scads of ways to save money and still have a handsome, well-constructed building that will be efficient and relatively easy on the maintenance budget. The trick is to want to do it, assemble a team that can do it, and then *do* it.

# 11

# Landscape Development

University and college administrators should be the first to recognize the importance of properly planned, developed, and maintained campus grounds. However, good outdoor "housekeeping" is lacking at far too many schools. On many campuses buildings, walks, streets, and parking lots have replaced tree-studded open lawn areas. Perhaps the change was necessary, but too often what potential for good landscape development did remain was not realized. This is strange: on the one hand, administrators at all schools are very much aware of their public image; on the other hand, far more people see the grounds of a university or college than ever see inside their buildings.

"Fortunately, the college campus is one system of outdoor space relationships which has not been invaded by commercialism. It is, in all probability, the one element of our culture most responsible for offering a controlled living environment conducive to delight and peace of mind. Daily experiences of movement about the campus often have a more profound effect upon the student than do his classroom contacts."[1]

"Every school and college has an atmosphere, a quality of personality that makes a lasting impression on students, teachers, employees, and visitors—

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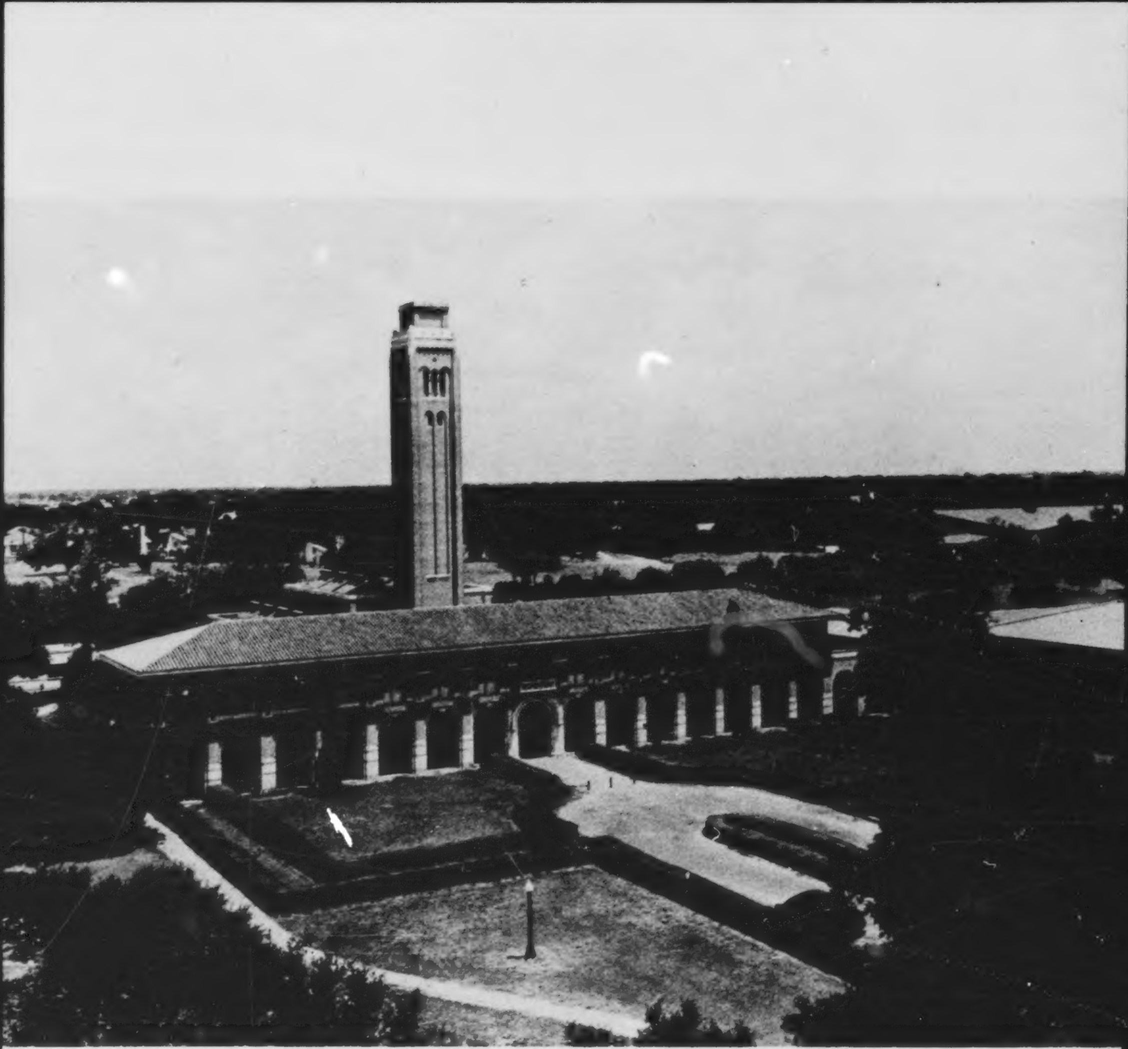
[1] Robert F. White, Professor of Landscape Architecture, Texas A and M University, "Campus Landscaping," Paper given at the Fifty-First Annual Meeting of the Association of Physical Plant Administrators of Universities and Colleges, Trinity University, 1964.



An innovative solution to a practical problem. The smokestack of Rice University's central energy station, located behind this attractive academic building, could have been an eyesore. The solution: a campanile, complete with bells *and* two vent stacks. The result: vents for the energy station, and a distinctive landmark.

few people forget the surroundings in which they were introduced to man's collective historical experience."[2]

"There is in landscape design a potential enlargement of educational processes which has rarely been explained."[3]

Certainly it takes professional knowledge and money to have well-

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2. Garrett Eckbo, Resident Partner of Eckbo, Dean, and Williams, Landscape Architects, South Pasadena, California, "Landscape Design Potentials for Education," *American School and University*, 1960-61, 32nd ed., (Buttenheim Publishing Corp.: New York), p. 21.

3. Eckbo, "Landscape Design Potentials for Education."

planned, well-constructed, well-maintained college and university grounds. It also takes money, and a lot of it, to plan, construct, and maintain buildings, and to acquire and maintain a competent staff. Why then should the grounds—which, more than anything else, tie all the physical development together and make the entire school plant a more attractive, livable, and harmonious whole—be neglected or given a secondary role?

Well-kept, functional academic buildings are a prerequisite to good teaching today. By the same token, the areas around these buildings should be such as to complement the structures and to further aid the academic processes by providing some relief from the crowded conditions of the modern campus.

**Landscape Architect.** Because sizable landscape projects require many skills, best results are generally obtained when an architect, an engineer, and a landscape architect combine their talents. Of course, the landscape architect relies heavily on plant materials. However, there is much more to landscape architecture than plants (just as there is much more to architecture than steel, brick, and mortar). A school might accomplish its landscape work by employing an outside professional landscape architect on a part-time basis or by employing a professionally trained landscape architect on a full-time basis to serve on the school staff. Both methods are in use. It is recommended that any school really interested in a better organized and more attractive campus hire a full-time graduate landscape architect, and that it call in outside professional landscape architects if and when they are needed.

The professionally trained landscape architect is proficient in doing many things needed on a campus. He, together with the campus architect, should be responsible for developing and keeping current the campus master plan. He should work with project architects in the preparation of grading plans, site development plans, orientation of buildings, conformity to the master plan, outdoor-construction details, road and street alignments, profiles and cross sections, and many other things.

The campus landscape architect should work closely with the project architect in determining floor elevations and building grade lines. Architects often set their buildings so low that draining surface water away from them becomes extremely difficult and expensive. The information many architects provide on their site and grading plan is so inadequate that contractors cannot properly bid or construct that portion of their projects. Consider this example: on one sizable building project, the architect put practically all his grading and site information on the cover sheet, however the university landscape architect prepared seven sheets of grading and site development plans and a number of pages of specifications before the owner's representative would permit the project to go out to bid.

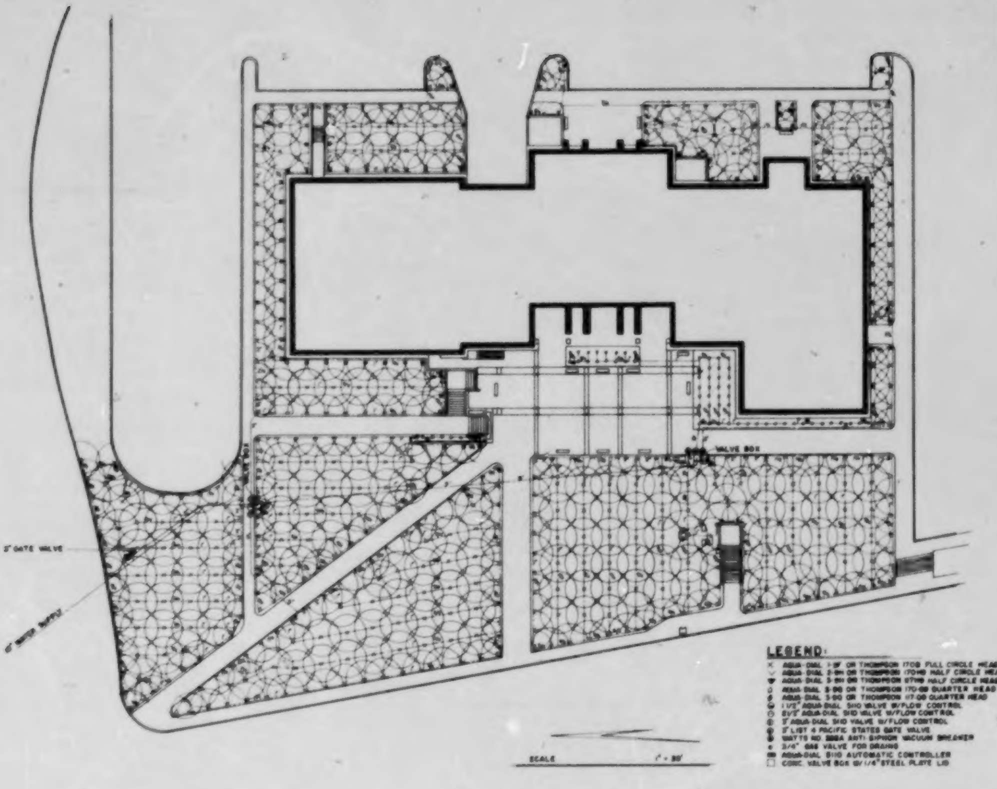
Universities and colleges offer almost unlimited opportunities for architectural and landscape architectural expression. The Rice University Quadrangle is a pleasing example of a style not often found on American campuses.

While the architects are preparing working drawings, the school landscape architect should prepare sprinkling system plans and planting plans. A properly installed sprinkling system requires pipes under walks, drives, patios, and other paved areas. It is far better and less costly to put in properly located pipe sleeves before such areas are paved so that pipe can be installed later without damage to the paved areas.

Too often buildings are constructed and occupied for many months before lawns and landscape plantings are done. Landscape development should be included in each project budget. Lawns and plantings should be completed by the time the project is ready for occupancy. It does not cost any more to do it early than to do it months or years later. Completing the landscape work early will prevent having a lot of mud and dust tracked and blown into the buildings and will reduce custodial costs. In addition, the simultaneous completion of the landscape work with the completion of the project will produce countless compliments from school staff and the public.

**Master Campus Landscape Plan.** It is highly desirable to have a master campus landscape plan. Spotty hit-and-miss plantings and ill-advised treatment of outdoor areas can ruin the appearance of a potentially beautiful campus. Full attention should be given, as early as possible, to existing physical resources. Trees, streams, ponds, undulating ground forms, vistas, and other natural features all have great potential for beauty if they are carefully incorporated into the campus master and campus landscape plans. It is here that the landscape architect can be of inestimable value. His knowledge of nature and of natural features nicely complements the architectural and engineering professions.

Although the landscape architect with professional training should generally supervise grounds work, including the grounds foreman, a landscape architect's main strength is in design. He should prepare all landscape plans. He should be the one to determine what to plant and when to plant it. He should design landscape features and see that they are constructed according to his plans. If changes are to be made in the plans, he should make them. The grounds foreman and his crews should be responsible for maintenance, and they should be highly skilled in all the many requirements necessary to keep a campus landscape flourishing. They should not be the ones to determine how and where landscape features are to be built or where landscape plantings are to be made. These should be the responsibility of the landscape architect. On a college campus it isn't too unusual to find everyone getting into the landscape business. Certain people just *must* plant something at certain times; and because they know *how* to plant, they also figure they know *where*. Some who wouldn't think of asking a groundsman to teach do not hesitate to tell the campus landscape architect and the grounds people how to plant, prune, and spray. Many teachers are, of course, experts in related fields such as horticulture, agronomy, botany, floriculture, and entomology. Their advice and counsel should be sought. Likewise, staffs of landscape departments can be used as consultants and advisers. But they should have no administrative responsibility for the campus landscape. Furthermore, teaching and research is, or should be, a full-time job. And grounds maintenance certainly is. Thus, any school would be wise to develop a strong landscape section in its Physical Plant department and not rely on academic personnel for supervision of campus landscape work, either design or maintenance. The campus landscape should develop by plan; and as in most things, there should be a head man who accepts full responsibility for what is done. It should not be done by a committee or by a group of academic


VALVE BOX
LEGEND:
3" LIST 4 PACIFIC STATES GATE VALVE
3/4" GAS VALVE FOR DRAINS
AQUA-DIAL 5110 AUTOMATIC CONTROLLER
CONC. VALVE BOX W/1/4" STEEL PLATE LID
SCALE

A really good campus landscape needs a sprinkling system to assure that water will be available when needed and in the proper amounts. The above sprinkling plan provides for a system that, when properly installed, will insure that the lawns and plantings specified for the project will grow under optimum conditions. (Plan prepared by Boyd D. Datwyler, landscape architect, Department of Physical Plant, Brigham Young University.)

people working at the job when it suits them. The man who should be held responsible is the director of Physical Plant; and because he can't do it himself, he would do well to get capable people on his payroll who can.

Once the landscape architect has his design completed and approved, construction and maintenance are accomplished by many trades: civil engineers, grading contractors, masons, carpenters, electricians, plumbers, painters, ornamental horticulturists, floriculturists, and maintenance men such as gardeners, sprinkling-system operators, grass mowers, and experts on insecticides and fertilizers.

**Equipment.** Proper equipment for construction and maintenance is a necessity. Without the right equipment and a trained crew, it would be next to impossible to develop and maintain an adequately landscaped campus of any size.

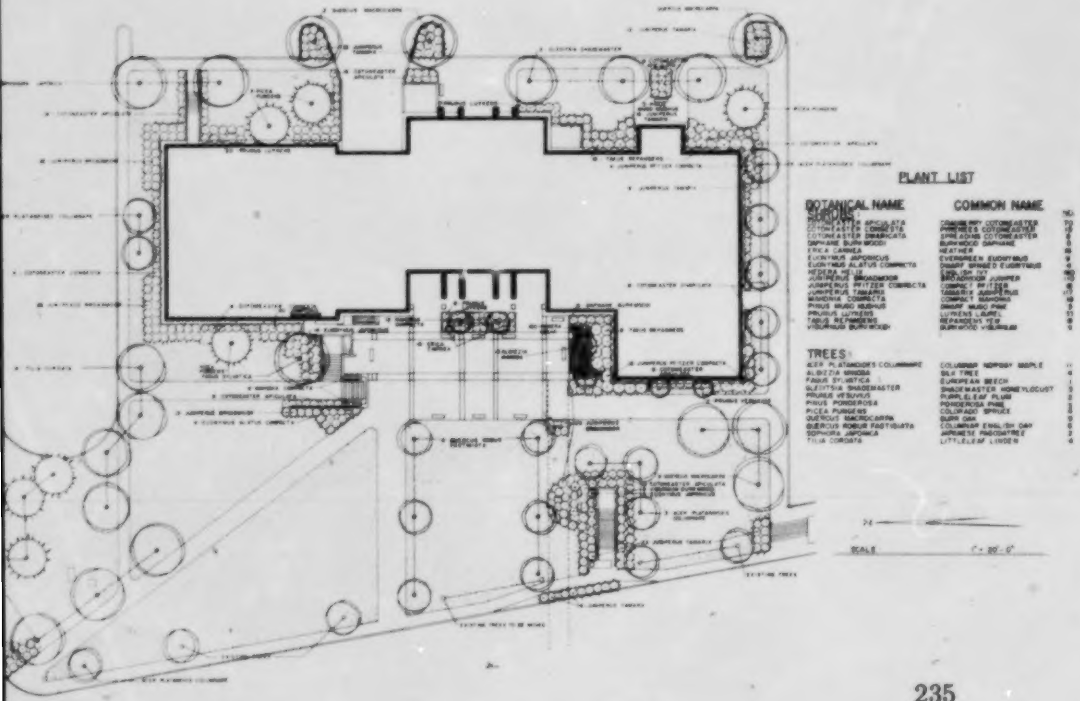
Depending on the extent of the campus, the following are pieces of equipment that experience has shown to be extremely useful in developing and maintaining university and college grounds. If only two pieces of heavy equipment could be acquired, the best choice would most likely be a combination front-end loader and back hoe, and a good motor patrol. A water wagon is useful, not only for washing streets and parking areas, but also for watering hard-to-reach trees, shrubs, and sections of lawn.

There is a bug or a disease for almost every tree. To keep trees healthy, it is essential to have a power sprayer that will reach to the top of the tallest ones. A tractor equipped with a pressurized tank and a sizable boom is most useful in spraying and keeping weeds under control.

Other extremely desirable pieces of specialized equipment are a flail mower; a transit concrete mixer; a motorized auger that digs holes for signs, fences, shrubs, and tree plantings; a landscape machine that scarifies, levels, rolls, rakes, seeds, and fertilizes; and a sod cutter.

There are all kinds and types of mowing and edging equipment. Personal preference, as well as type and amount of lawn and lawn condition, will help determine their selection. The number of dump trucks, stake-body trucks, and smaller grounds maintenance vehicles will depend on the amount of construction work done and the size of the campus.

Planting plans for campus projects should be prepared by landscape consultants or by a professionally trained landscape architect employed as a fulltime staff member. (Plan prepared by Boyd D. Datwyler, landscape architect, Department of Physical Plant, Brigham Young University.)



Proper equipment for construction and maintenance is a necessity. Without adequate equipment and a trained grounds crew, it would be next to impossible to develop and maintain an adequately landscaped campus. Here we have seven men and seven pieces of equipment headed for the section of the campus where they will work together as a team in mowing and edging.

Good and ample equipment and good and ample personnel go together; one without the other will not produce or maintain a good campus landscape.

There is a great deal of merit in a school having a grounds section capable of doing landscape construction projects such as rough and finish grading, drainage systems, sprinkling systems, preparation and sodding, or seeding of lawn areas, and the planting of shrubs, trees, and all other plant materials. Additional construction work, such as walks, paving, retaining walls, structures, electrical, and painting, can be done by other sections in Physical Plant. If not too extensive, landscape construction can be done by Physical Plant personnel with the same equipment used for grounds maintenance and other campus maintenance work. It can be done with fewer plans than would be necessary if the work was bid, and it can be done as needed. A school that has a grounds section trained to do such work, and an experienced graduate landscape architect to see that the work is done professionally and in accordance with good design, can almost be assured of a far better than average campus landscape.

An orderly campus must start with a well-conceived master plan. Good landscape plantings may soften a poorly arranged campus so that it will appear in a better light to the casual observer. But beauty alone is not enough. The campus should be functional in every respect, and plantings should only complement and help unify the whole physical plant. Good design is essential from the original concept of the campus and through all its buildings and building components if the campus is to be both functional and beautiful. The professional landscape architect working with architects and engineers will help bring these conditions to pass.

Many elements taken together comprise a campus landscape. How well these elements are handled and how well they relate to one another will determine how the campus will look. The most spectacular element, the one that will quickly catch the eye of the casual observer, is the landscape planting. And perhaps the most important single part of that element is good lawns. Good lawns properly maintained are not only pleasing to the eye, but they are practical. Among other things, they reduce sun glare and help cool the hot summer days.

Trees come in all sizes and shapes, and they are the most spectacular part of the campus landscape. Some are tall and slender; some are as wide as they are tall; some lose their leaves in the winter, while others do not; some are best used for shade, while others are best used as specimens or for accent purposes. Good lawns and healthy, natural growing trees are an unbeatable combination. However, care should be taken in the selection and location of trees because of their many different characteristics. A tree may be a tree to most people; but to a person thoroughly familiar with trees and their habits, they are as different as people are different. The landscape architect will know which are best to use to accomplish a desired effect.

A plan that has worked well at Brigham Young University is to consider the entire campus an arboretum. The Botany and Ornamental Horticulture departments gave the Physical Plant landscape architect a list of plant materials they would like to see on the campus. Their main purpose, lacking an adequate arboretum, was to get as many plants as possible for observation and for teaching. However, it was understood that nothing would be used that did not fit its location. Nothing would be used just to provide another plant. There are two results: many plants are now growing on the campus that would not have otherwise been used, and they are growing according to campus landscape plans.

Often buildings, walks, streets, and parking lots have replaced the tree-studded open lawn areas that once existed on many campuses. This was probably a practical necessity, but it is too bad because every school should be aware of its public image, and more people see the grounds than see inside the buildings. This photograph is of a much-appreciated portion of the Brigham Young University campus.

"For various reasons, it is often important to have as large a collection of plants as possible on a campus. If there is no space for an arboretum as such, the collection may become part of the general campus landscape planning. However, such an approach could become disastrous if it were not expertly handled."[4]

Shrubs constitute a large part of any landscape planting, and the number of available species and varieties is almost unlimited. They are used as foundation plantings around buildings, as border plantings, and in many other ways, including screening from view some objectionable campus object. Plantings should be made with the seasons in mind. Few plants look their best all the time, but the fall of the year can be just as colorful as spring if some plantings are selected with fall in mind. One of the nicest landscape features a campus can possess is a large uncluttered lawn enclosed and framed by a border planting in good scale to the area involved. Include in it the proper number of good shade trees, some flowers for color, and some benches in the shade of the trees, and you have one element in a good campus landscape.

Flowers are the frosting on the landscape cake and, when properly used, do much to brighten and enrich any planting. They should be used to supplement and complement a landscape, not to dominate it. When money is a serious factor so far as the campus grounds are concerned, more can probably be accomplished by putting available funds into developing and maintaining lawns, trees, and shrubs than by putting those same funds into extensive beds of flowers.

Vines and ground covers are all part of a campus landscape. Sometimes vines are allowed to completely wrap a building, including the roof. Vines can do much to soften and make a building more attractive, but a tracery of vines is often all that is needed. Ground covers certainly have an important use, and in some parts of the country they practically replace grass. However, in other parts of the country, where many varieties do not seem to do well, the landscape designer is limited to a very few species and varieties. Generally, experienced grounds people will know what will do well and what will not. However, those who are in doubt would be wise to turn to the school's Botany or Horticulture departments, to the County Extension Service Office, to the appropriate specialist in the Extension Service at the State Land Grant University, or to the "Green Thumb" editor of the local paper.

There is no practical reason, unless it be money, why plants should be limited to the outdoors on a campus. Tropicals and semihardy plants of many kinds grow well indoors with proper care, and they can do much to add freshness and interest to the interior of a building. The architect and the landscape architect can find many appropriate places to grow indoor plants. Stairways, reception areas, and public areas afford good opportunities for creative design. However, tropicals must be taken out and given a rest occasionally. They also need to be divided and reworked from time to time. A greenhouse is almost a necessity if much of this kind of work is to be done.

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[4] White, "Campus Landscaping."

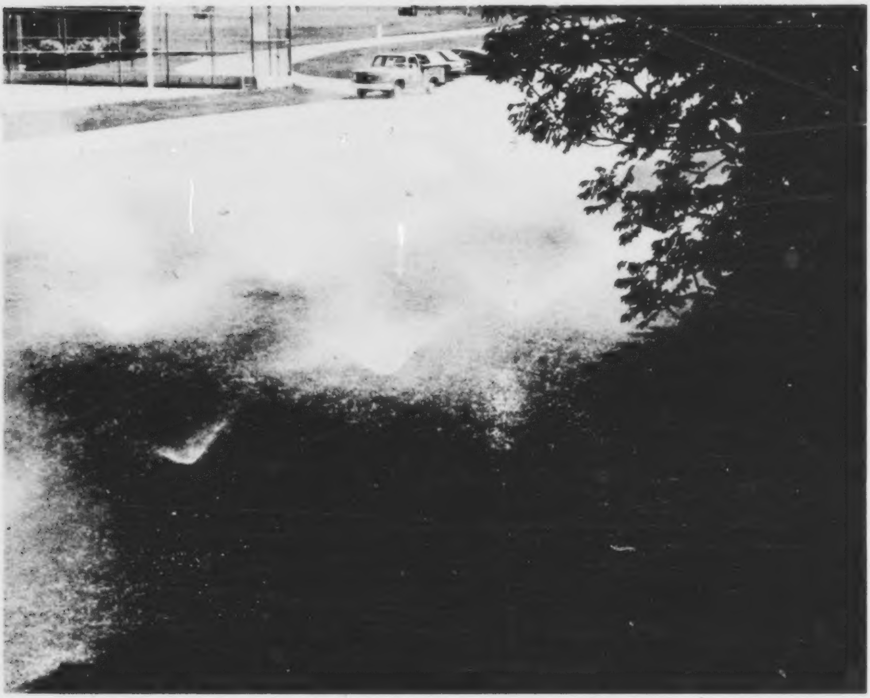
Water is perhaps the most important single item in maintaining a good lawn or a complete landscape. The important thing about water is to have it when and where needed and in the proper amount. Fifty inches of annual rainfall won't maintain a good campus landscape because it does not always come at the right time or in the correct amount. Several inches of rain in a short time followed by days of hot, dry weather will not support a good landscape. For best and most dependable results, a sprinkling system is recommended. It can be an underground system with pop-up heads, or it can be an above-ground system, but (again, for emphasis) the important thing is to put the water where it is needed when it is needed and in the right amount. Sprinkling systems need to be designed with care because they are too expensive and too important to be left solely to a plumber. The school landscape architect should prepare sprinkling-system plans, and they should be carefully coordinated with his landscape planting plans.

Often rather monumental projects are constructed as part of the campus landscape. A large fountain, quadrangle, or landscaped mall might serve as a central motif for the entire campus. The landscape architect, the architect, and the engineer can cooperate to great advantage on such projects, all of which should be part of the campus master and landscape plans.

Sometimes, a well-meaning donor will offer the school a sizable sum of money to build something he thinks the school should have. Most of such projects are worthy and can be made to fit logically into the campus plan. If one cannot be worked in well, however, it should be politely refused with thanks. Such gifts should not be accepted until their location and use have been studied and approved by the campus architect and the landscape architect.

Sculpture can add much to a campus landscape if appropriately designed and scaled and not used too much. It has always been an important part of landscape designs and was used to great advantage in many Old World gardens and parks. Its use should be encouraged, but location and treatment should be decided only with the advice and help of the professional landscape architect and the professional architect. Sculpture can be bare and cold, and it is often located by enthusiastic people with few or no qualifications for the job. This need not be; when appropriately selected and given a proper setting, sculpture can add greatly to man's enjoyment of his surroundings.

There is no reason why plants should be limited to the outdoors. Tropicals and semihardy plants of many kinds grow well indoors with proper care, and they can do much to add freshness and interest to the interior of a building. The architect and the landscape architect can find many appropriate places for the growing of indoor plants. Tropicals must be given a rest occassionally, and need to be divided and reworked from time to time. A greenhouse is almost a necessity if much of this kind of work is to be done.



Water when and where it is needed and in the proper amount is the most important single requirement for a good lawn or a good campus landscape.

## Summary

More people see the grounds of a university than ever see inside its buildings. The condition of the grounds makes lasting impressions on students, staff, and visitors. Money should be budgeted for site development at the same time it is budgeted for a building or a campus facility. The director of Physical Plant should be responsible for the campus landscape, and he should have a professional landscape architect and a good grounds crew to design, supervise, and do the work. Ample equipment and trained and experienced personnel are essential to a good campus landscape. There should be a campus master planting plan as well as a campus master plan, and the university landscape architect and the university architect should cooperate to maintain the integrity of both plans.

# 12

# Planning for Changes

It would appear that a building programmed by the people who will use it and planned under the watchful eyes of those same users would not require immediate alterations and changes. But usually a building is barely occupied before requests for changes start coming in. At first they are for rather minor alterations, but as time goes on the requests are often for major alterations or even additions. New personnel and program changes multiply the requests for building changes. When such a request occurs, two conditions must be faced immediately. First, is the requested alteration really necessary? Second, has it gone through channels and obtained all the necessary approvals?

Often such a request will reach the Department of Physical Plant through a dean, director, or department head without justification and without necessary approvals. That means the director of Physical Plant or his staff must determine whether or not the proposal is needed, and, if it is, they must obtain administrative approval to do the work. No one in Physical Plant feels comfortable about telling a dean that he does not need what he is requesting, but the director of Physical Plant may feel strongly that the request is not justified.

It is at this point that a director of space utilization is needed. He, better than anyone else, should be able to determine whether a request to divide a small classroom into two offices is desirable or needed. A pair of available offices that the dean did not know about might save a classroom and the expense of remodeling. Many times a director of space utilization has been able to solve a request for a building change by helping to reassign existing space.

On the other hand, a request could be determined to be necessary. Then the only solution is to alter existing spaces or, if sufficient space is not available, to build an addition When alterations and changes are justified, the director of space utilization should work with Physical Plant in obtaining an estimate of cost. He should then assist the dean in obtaining administrative approval.

Once a project has been approved and financing at least tentatively provided, the president, the provost, or the academic vice-president should write either the director of Physical Plant or the school architect to inform them that the project has been approved and that planning may proceed.

When a director of space utilization is not available, the director of Physical Plant or the school architect should do what is required to establish the validity of the request and to activiate the project or assign someone to do it. For a small project, such as dividing a classroom into two offices, the procedure might be to get the necessary approvals, arrange the financing, have a rather simple drawing made by a school draftsman, and have Physical Plant issue a work order to do the work.

For a project too large to be handled by school personnel, the first step would be to get approval to proceed with the project. After approval is granted, the next step might be the preparation of a Program of Requirements. This could be done before an architect is employed; or perhaps the Program of Requirements could be eliminated, and the architect could get his information directly from the users. When plans are developed and approved, the construction work might be done by the Physical Plant Department, or the work could be bid or negotiated with a construction firm.

Every college or university, large or small, should have a planning office. It might be staffed with only one draftsman located in a corner of the Physical Plant building, or it might be staffed with an architect and an assortment of engineers and draftsmen. The size of the planning office would depend on the size of the school and on whether or not the physical facilities of the school are constantly expanding to accommodate an expanding curriculum and staff. But whether the school is large or small, growing or relatively static, there will be enough requests for physical facilities changes and improvements to justify a planning office of appropriate size. Every school should be so organized that when a request is made by a faculty or staff member for an alteration, an addition, or a new facility, the request can be handled expeditiously through clearly defined channels.

One of the problems a director of Physical Plant has is keeping a steady flow of work passing through his shops. There are times when the shops could not work on even a small alteration project without neglecting their regular responsibilities. But there are times when shop supervisors would welcome a small construction project to keep their work forces intact. On alteration jobs the Department of Physical Plant should be consulted to see if they could undertake the work before turning to outside forces. Some schools, where the law will permit, have supplemented their regular forces and have constructed sizable projects, including buildings. Just a word of warning, however: there aren't very many Physical Plant departments that can do much construction work without interfering with the maintenance and operation of the existing physical facilities. Keeping maintenance personnel away from their primary responsibilities for too long a time will result in deferred maintenance, and that can become very costly.

Building spaces *will* be modified during the life span of an academic building. Thus, possible future changes should be considered during the initial planning stages. One big expense in reworking a large room into smaller spaces is in rearranging the electrical, air-conditioning, and heating systems. In planning spaces likely to be altered at some future date—and most of them will be—careful thought should be given to locating light fixtures, convectors, and diffusers in positions that will allow future partitions to fit between them.

"But both in air-conditioning and in lighting, we still find room for major improvements in performance and design. The control features of the equipment are still cumbersome, inefficient, and old-fashioned. These features place strict restrictions on the spatial flexibility in our schools today."[1]

Making partitions non-load bearing facilitates their later removal, but even then they are difficult and costly to tear out and rebuild. The use of movable partitions is becoming much more prevalent. Great improvements have been made in the design and construction of such partitions. Some of the earlier so-called movable partitions were about as easy to move as a cinder-block wall; today, some of the best movable walls as produced by some of the leaders in this field not only look good, but are fairly easy to install and to move and rearrange. Furthermore, they probably resist the transfer of sound from one room to the next as well as or better than a four-inch block wall does. Chalkboards, tackboards, shelves, and cabinets can be easily fastened to the walls. Where extensive rearrangements are probable, movable partitions should certainly be given consideration.

Where movable walls are used, it is advisable to give careful thought to the arrangement of lighting fixtures and the type of heating system. In large open areas in buildings, it is now becoming quite common for the mechanical engineer to design the heating system to take care of the heat loss around the perimeters and to depend on the heat-producing elements in the building to heat the balance. Heat can be introduced through the light fixtures and returned around the perimeters. This type of system improves the flexibility of portable partitions because space rearrangements do not mean that the mechanical system must be revamped so extensively. Because every school building undergoes extensive functional rearrangements during its lifetime, anything that can be done in planning and construction to make future changes easier and less costly should be given prime consideration. Certainly, movable walls and open space or office landscaping are two good possibilities.

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[1] Dr. James D. MacConnell, Director of School Planning Laboratory, School of Education, Stanford University, "An Invitation to Industry," *New Ideas for School Construction*, Seminar by the Producers' Council, n.p.,n.d.

"We will see the educational programs, methods, and equipment of yesterday become obsolete and be discarded in another decade. However, the building structures designed to house current and future programs will remain with us for a long time. It is, therefore, of utmost importance that *facilities* be designed for the maximum amount of flexibility to accommodate unknown future programs."[2]

"Within the new concept of flexibility, walls have become the prime target. But a school facility cannot fulfill its long-term obligation if flexibility does not extend to structure, lighting, air-conditioning, and other building elements."[3]

Research laboratories are often rearranged to accommodate the work being done at a specific time. For example, many things in a laboratory are either suspended from the ceiling or dropped to the benches from overhead utilities. Thus, it is more economical, both in the initial construction and in later rearrangements, to omit a dropped ceiling. But before making this decision, the planners should give careful thought to the importance of acoustics in laboratories. If the laboratory will also be used as a lecture room, an acoustical ceiling might be a necessity. (From the standpoint of appearance, however, a laboratory without an acoustical dropped ceiling can be made acceptable.) To further complicate things, there is the problem of changes of intent. In one particular life-science building, the architect and the campus planning coordinator were given to understand that the laboratories would not be used for lectures. But no sooner was the building occupied than professors were complaining about the poor acoustics in certain laboratories. Investigation determined that contrary to previously expressed intent, the labs were being used for lectures. Without acoustical ceilings they were all right for lab use but inadequate for lectures. As a result, acoustical ceilings were installed in several large laboratories within a year or two of occupancy—a job that could have been done far more economically under the building construction contract.

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[2] MacConnell, "An Invitation to Industry."

[3] MacConnell, "An Invitation to Industry."

Providing telephone outlets and electrical convenience outlets to serve changing arrangements is a difficult problem. As an example, on an office floor in a very fine and costly building, the architect talked with every user and made furniture layouts for each and every office. Then, after each user had reviewed and approved the layout for his office, the architect and his engineers provided floor conduits and outlets at the proper spots to serve the desks and tables. At the time of first inspection, it was one of the cleanest and most logical arrangements anyone could wish for. But six months after occupancy, it was a different story: almost without exception, the occupants had completely rearranged their offices, and those fixed outlets in the floors no longer served the changed situation. As a result, none of the schemes used to serve the new arrangements were as attractive as the originals.

School architects and administrators should recognize that little will remain unchanged in a university or college building over a period of years.

Every school should have a planning office. It might be staffed with one person or several, but there are always enough requests for physical facilities changes and improvements to justify a planning office of appropriate size.

## Allied Subjects

Changes in occupancy and usage might not occur as often as in a large commercial office building, but there are many similarities between commercial office buildings and university and college buildings. Tenants in each do change, and the requirements of each new tenant do vary from those of his predecessor. Commercial developers, planners, and builders must please sophisticated and demanding tenants *and* do it so as to allow a reasonable return on their investment. Many methods used in commercial buildings could very well be adapted to university buildings. It is quite probable that school people are generally less inclined to try new concepts in planning and usage than are people in commercial fields. Open-space planning, for instance, can be found in almost any modern bank and in many public and private enterprises employing or serving large numbers of people. However, it is still resisted by most teachers and administrative staff at universities and colleges. It is difficult to understand why, when a high-ranking bank official can conduct confidential business in a large space shared by other bank employees, the assistant professor, graduate student, or rank-and-file staff member must have a private office. The increased cost of constructing, operating, and maintaining a building is influenced to a large degree by the number of small rooms it contains. Thus, there is a strong possibility that an association between an architect specializing in commercial structures and the architect commissioned to do a university building could prove profitable to the school.

## Summary

Changes, alterations, and additions to existing university and college buildings seem to be inevitable. Thus, every provision should be made in the initial planning to enable them to be made as easily and economically as possible. Private industry has developed methods and techniques that could be adapted to the design and construction of university and college physical facilities. Alterations and changes are so expensive that every effort should be made to care for new requirements within existing physical facilities. When the need for change is justified and approved, the planning should be done by architects and engineers.

# 13

# Building Obsolescence

Much has been written on this subject, and it is doubtful that there are many schools that have been in existence for fifty years or more that haven't had to decide whether to tear down "Old Main" or some other "old timer" or to try and bring the building to current standards and keep it around for another generation or two. Formulas have been developed which purport to make it easy to decide which to do. If the pluses outweigh the minuses, keep the old building; if the minuses outweigh the pluses, tear it down and build anew. That sounds like a sensible approach, and on paper it should work; but as with many situations in which sentiment and emotions become involved, facts and formulas sometimes take a back seat.

The fact remains that it isn't easy to tear down a building that has provided shelter and educational opportunities to thousands of young people who are now old. These alumni look upon the old building with a great deal of nostalgia and feel very strongly about having it torn down to be replaced with "a modern factory-looking building that won't be half as well built." Perhaps that is the one factor that makes the formulas less than perfect. How much consideration is to be given to the sentimental attachment and love so many people have for a particular building? There must be late-nineteenth century and early twentieth-century buildings that are still standing more for sentimental reasons than for their functional adaptability to present-day instruction or their compliance with 1977 building codes.

However, in this realistic age, it is often deemed necessary to do what appears to be most practical and economical, regardless of historical, sentimental, or traditional values. Perhaps it is true that, if renovating "Old South Hall" would cost 40-60 percent of the cost of a new building, the sensible thing would be to raze it and construct the new building; otherwise, after spending all that money, "Old South Hall" would still be an old building not compatible either functionally or in appearance with the newer buildings around it.

Nevertheless, when news of the intent to raze "Old South Hall" is released, a prominent alumnus of the class of '06 is likely to say, "I don't care if it costs twice as much to renovate Old South Hall as it would to construct a new building. I am for keeping it because the place just wouldn't be the same without it." This wouldn't be so bad if it was just one old grad expressing himself; but most likely the '06 alumnus would soon be joined by other alumni, and the pressure on the president and the trustees could become something to reckon with.

It would seem that the only practical thing to do is to make a thorough study of the functional, structural, and economic pros and cons and then go ahead and do what the study indicated. However, a concerned administration will also want to give consideration to sentimental and historical values. Occasionally, an old building should be kept because it is a splendid example of a certain architectural style.

Today great interest is being taken in the preservation of buildings of historical interest. All over the country, buildings are being registered with the National Registry of Historical Places and designated as historical structures. When a building is so designated, it is not likely to be torn down or even remodeled to any great extent without creating a real furor. When such a building exists on a college campus, it is quite likely to remain whether it has any great functional value or not. On the other side of the coin, however, it is true that state legislatures and other funding agencies take a dim view of spending large sums on a building that has already served its allotted span of years. Often they rationalize that the thing to do is to "spend as little as possible on the old building and squeeze a few more years of service out of it."

An administration faced with this situation must have some compelling facts if it is to convince its funding body that what they are suggesting has been done for years; and now the choice is whether to spend a large sum of money to completely renovate "Old South Hall" or to spend even more to tear it down and construct a new building.

Some reasons why an old building might be kept are as follows:

1. It can be made to serve satisfactorily the disciplines that are or can be housed in it.

2. It fits into the campus development plan so far as its size and location are concerned.
3. It may not resemble the newer buildings, but it is a good-looking structure.
4. It is a good example of a fast-disappearing architectural style.
5. It is large enough in net assignable square feet to justify its remaining on the valuable tract of land it occupies.
6. It is a historic building, and there is much sentiment attached to it.
7. Architects and engineers have carefully gone over the structure, and they estimate that it can be completely renovated, air-conditioned, and brought into compliance with existing building codes for less money than a new building of like square footage would cost.

An additional argument in favor of the old building would be an architects' and engineers' estimate of cost that is 50 percent or less of the cost of a new building. Another factor is the expected life of the old building after it has been completely renovated. A new, well-constructed building should be good for seventy-five years or longer. Would the renovated building have a life expectancy approaching those figures?

The following are reasons for replacing "Old South Hall":

1. It is too small to be useful any longer.
2. It is a sizable building, but it has a poor foundation and cracks in the walls and is not pleasing in appearance.
3. It is located on the site of a planned development and cannot be made to fit logically and functionally into the new plan.
4. It is completely out of character with the buildings around it.
5. There is little sentiment for keeping it.
6. The land it is located on is worth considerably more than a building of its size would be worth after renovation.
7. Architects and engineers have carefully gone over the building. They report that, partially because of its structural condition, it might cost an amount approaching the cost of a new building of like size to make it structurally sound and functionally acceptable, to air-condition it, and to bring it into compliance with building codes.

When considering whether to remodel or remove a building, it would be very wise to consult the architect who designed the building. This can often be done. However, many such buildings will also have outlasted their designers.

*That aspect of the construction field which is greatly neglected is the reporting by the owner to the architect/engineer on the functioning of the facility*

"Old Main," Utah State University. Constructed in three phases, this building started in 1886 and completed in 1903. It contains 138,297 gross square feet, and the interior has been rearranged many times to accommodate changing personnel and programs. It has served long and faithfully and is rich in tradition.

*throughout its lifetime. . . . After the first several years of the life of the facility, a long period of stable use sets in; and the exchange of information between owner and architect dwindles to zero. Fair enough—but at the first signs of 'incompatibility' between the facility and its users, generally brought on by the changing of the habits or requirements of the users, communication with the architect should be resumed. Modification of some features, mechanical or architectural, may extend the satisfying life of a facility again as much as the expired time."* [1]

Whether the original architect is available or not, it is wise to seek advice and help from an architect, a structural engineer, a mechanical engineer, and an electrical engineer before definitely and finally deciding whether to demolish or keep an old building.

According to Report #20, published in *Higher Education Panel*, September 1974, the mean amount of space that needed renovation varied between a low of 6.9 percent at public two-year colleges to a high of 19.7 percent at private universities. This would certainly seem to indicate that a great many people at a great many universities and colleges are going to have to make a great many decisions in the next few years on whether to raze or restore some of their buildings. "Unfortunately, many colleges and universities underestimate the opportunities for making new use of old space. Their most frequent failing is the inability to visualize a significantly different type of use."[2]

Buildings may be completely gutted, leaving little but the four walls and the roof, and brand new insides installed. It has been done, and it will be done more often in the future because of new building costs. It might be likened to the practice of the old gentleman who said he was going to have his radiator cap jacked up and a new car run under it. It is perfectly feasible if the old building is structurally sound and if the finished product will adequately serve its new functions. Certainly if the building is an excellent piece of architecture or has great sentimental or historical value, it should be seriously considered.

One of the first questions generally asked in a discussion about remodeling an old building is "What will it cost?" At that early stage the question is almost like asking how long is a string or how high is up. It is hard enough to

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[1] Frank H. Bridgers et al., Bridgers and Paxton Consulting Engineers, Inc., Albuquerque, N.M., *Building and Construction Guide for the Owner* (New Mexico Building Trades Group: Albuquerque), n.d.

[2] Calvert W. Audrain, Director of Physical Planning and Construction, The University of Chicago, "Want to Renovate? Here Are Steps to Consider," *College Management*, Aug.-Sept. 1973.

Samford Hall, Auburn University. This grand old building was constructed in 1888 and has been in constant use since. Through the years, its interior has been renovated many times to meet the needs of a growing school. It was originally heated by fireplaces and "pot-bellied" stoves and was lighted by kerosene and gas lamps. (Some of the twenty original chimneys may still be seen in this photograph, which was made in 1963.) In 1976 all four floors were completely modernized with central heating and air conditioning. The exterior remains substantially as originally constructed. It contains 49,376 gross square feet, but because of its thick load-bearing walls and extra-wide corridors it has only 30,537 square feet of net assignable space.

make an intelligent estimate of the cost of a new building with plans and specifications available. Before even attempting to make a reasonably accurate estimate of the cost of renovation, several things should be done. First, it should be determined whether or not the building is structurally sound enough to make further studies advisable. If it is, a list of proposed usages should be prepared—perhaps a program of requirements. The architect and engineers should then make some feasibility studies and sufficient drawings and specifications for the owner to decide if that is what is wanted. At that point, estimates of costs can be made by the architect, by a private estimating firm, or perhaps by a friendly or interested contractor. Even then, though, the odds are great that the estimate will be low, because one can never really know for sure everything to expect when remodeling or altering an old building.

When all the justifications for keeping or retiring an old campus landmark are balanced against one another, a person or a group of people must make the final decision. Two individuals—or two groups—might reach opposite conclusions even when presented with the same facts concerning the same building. Thus, in the final analysis, the fate of old buildings will probably be determined as much by individual feelings as by facts. As a result, some noble old buildings that have had the "headache ball" put to them deserved a different fate, while there are other old buildings still in use that should have been retired years ago.

It is hoped that school administrators everywhere will carefully evaluate all the factors for and against the next time the fate of one of their old campus buildings is at stake and that they will make the right decision.

### Summary

Old buildings sometimes outlive their usefulness or become so out of compliance with building codes that it becomes a question of razing or restoring. At that point in the life of such a building, it becomes a matter of economics, sentiment, historical value, potential use, and judgment. A decision must be made as to whether or not the building could be used effectively if it is judged structurally sound and if the cost of remodeling is acceptable. If the answer is yes, the school administration should have architects and engineers prepare feasibility studies and drawings that would enable a fairly accurate estimate of cost to be made. With this factual information, the school could then weigh all the other considerations and make a decision.

# 14

# Campus Traffic, Security, and Safety

**Campus Traffic**

Take several thousand pedestrians, several thousand automobiles, several hundred motorcycles, trail bikes, and motor scooters, a few thousand—more or less—bicycles, and throw in a few equestrians. There you have the traffic situation on the average sizable institution of higher learning in this country. School administrators must sometimes wonder if it isn't the current generation who discovered the wheel. It isn't unusual for a sometime campus pedestrian to have an automobile and either a bicycle or a motorcycle, or both—and perhaps a horse staked out not far from the center of campus. A few students around the country even have their own airplanes, but so far this hasn't become a serious campus problem.

Any campus planner today must take all these means of locomotion into account, and it isn't easy. A generation or so ago, the streets and an occasional parking lot took care of the automobiles, and sidewalks took care of the pedestrians. Today, a person using a campus sidewalk is just as likely to be run down by a ten-speed bicycle as by a sport model foreign job while crossing a campus street. A generation or so ago, the average campus was a fairly quiet place, disturbed only occasionally by a yell practice, an athletic event, a marching band, or a panty raid. Today, automobiles with four-barrel carburetors and two tailpipes race motorcycles with everything on them that Japanese manufacturers can devise to see who will be the first across an intersection when the light turns green, or the last across when it turns amber.

The designer of a completely new campus is fortunate: he can make provisions for handling pedestrians, automobiles, motorcycles, and bicycles at the same time that he is locating buildings, utilities, and other campus features. By contrast, the designer called upon to solve these problems on an old, densely settled campus really has his work laid out. It takes a lot of land, and a lot of money, to build parking spaces for several thousand automobiles on ground level. One acre of land cannot accommodate more than 140-150 parked cars. But while it takes considerably less land to park cars in multilevel parking structures, it takes considerably more money—unless land is extremely costly.

The truth is, college students and faculty members dislike walking any distance from where they park. Faculty members want to park close to where their offices are located, and students begrudge any preferential treatment given to faculty and staff. However, when land is not available in the heart of a campus, something less than what is desired or ideal must be done. Sometimes a combination of parking structures and ground parking as close in as possible solves the problem. Sometimes large parking lots are several miles from the campus, and the occupants of the cars are carried to and from the campus by shuttle buses. Just about every method of parking cars and controlling automotive traffic that school officials and campus planners can think of has been tried.

It is expensive not only to build parking facilities; it is also expensive to maintain and operate them. And as these costs have increased, so have the amounts charged for the use of the facilities. Owning and parking a car on campus can be a heavy additional burden to the already high cost of attending college. However, students seem to feel that it is just as much the responsibility of the school to furnish parking spaces as to furnish classroom buildings and instructors. And all but a few institutions of higher learning have made an all-out effort to oblige. From about 1946 to 1956, practically every conference held on campus planning or maintenance and operation presented at least one paper dealing with the "parking problem." In the past few years, most schools have done about all that they could or were willing to do; as a result, the question of cars and parking is not quite the red-hot topic of discussion that it was during the twenty years or so following World War II.

Bicycles. Just about when the car situation was beginning to ease off, America suddenly rediscovered the bicycle and the motorcycle, and new campus problems developed. Sidewalks intended for pedestrians suddenly became raceways for cyclists. One student put it fairly aptly when he said, "Being hit by a bicycle may not be as serious as being struck by a car, but it sure can skin you up real bad."

"The day may come when bicycles are limited on the campus due to the tremendous numbers and increased danger to pedestrians. According to the campus architect C. C. Jay, the suggestion for a bicycle-free central campus sounds pretty drastic, but there is a note of truth in Graphic Consultant Ernest Born's warning that 'the bicycle seems so primitive and innocent that its capacity for trouble is over-looked or ignored until it too usurps the scene.' "[1]

*The seriousness of careful bicycle use cannot be over-emphasized. Hundreds of injury-accidents involving bicycles occur each year on campus; if the regulations that follow seem overbearing, that's why. Riders and pedestrians should know these regulations and observe them; though some may seem illogical under routine conditions, one ought to remember there are also blind and wheelchair students that have trouble with bikes parked in doorways. Pedestrians in bikeways do cause accidents, and some night a light on your bike may help a 3,000 pound car see you. Please be careful and conscientious. Presently, there are an estimated 10,000 bicycles on campus each day. If you're one of the many, remember that there are 9,999 other bicyclists and 4,000-plus pedestrians using the bikeways and walkways with you.*[2]

Accompanying the increase in bicycles was a corresponding increase in thefts. As a consequence, bicycles appeared inside buildings, chained to stair rails and almost any other hard-to-move object. Outside they are chained to trees, signposts, stair rails, and any other stationary object. Thus, almost overnight in some sections of the country, bicycles became, not only a source of some danger, but an eyesore and another problem for campus planners.

"Davis [California] has become a mecca for stolen-bicycle rings. Ten-speed bicycles are the main targets. Physical features can be quickly changed, including the removal and replacement of serial numbers, which makes identification by the owner very difficult. Police report an estimated $100,000 in bicycles have met such a fate the last year."[3]

"Part of the community service officers' responsibility is to survey our bike parking areas especially during the evening and early night hours, watching for possible theft of bicycles; and they have been quite successful. This is a never-ending problem, and we do have bicycle thefts on campus; however, our campus police have been successful in breaking up some rings that were making a practice of stealing bicycles."[4]

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[1] Gerald Henderson, Landscape Architect, University of California, Davis, "Commentary on Bicycles," January 1976.

[2] University of California, Santa Barbara, *Bicycle Book*.

[3] Henderson, "Bicycles."

*In the fall of 1972, a new concept was put into action—the Community Service Officer (CSO) Program. Presently, the organization is a group of full-time students who work for the campus community on many public service projects, from teaching minority youngsters to swim to carrying out the bicycle program on campus. Among the CSO's responsibilities are bicycle patrols twenty hours a day, during which comprehensive checks of bicycle racks are made to find stolen bikes and to help deter thefts. Since the inception of the program, bicycle thefts have dropped 70 percent, and in 1974, 45 percent of the bikes reported stolen on campus were returned to their owners.*[5]

It would appear that bicycles on and off college campuses are here to stay in ever-increasing numbers. Half-hearted attempts at solving the problems they create may not be sufficient. It would be well for all schools, not only to plan for an immediate solution, but to take a good hard look into the future and to start making tough decisions and realistic plans to cope with future problems if and as they occur. Appropriate school personnel should be aware of the literature available to help with such planning. They should also know of work done at schools where "large-scale biking" is an old story and where much good work has been done to integrate cycling into the campus circulatory system safely and sensibly.

Probably no other college or university campus comparable in student size has as many bicycles as the Davis campus of the University of California. According to Robert P. Kelleher, administrator, Department of Physical Plant, there are approximately 30,000 registered bicycles on campus and in the city of Davis and an estimated 5,000 unregistered bicycles. The Campus Long-Range Development Plan text says, "the Davis Campus is truly characterized by the universal use of bicycles."

On August 31, 1972, De Leuw, Cather, and Company, Engineers and Planners, San Francisco, submitted a joint report to the City of Davis and to the University of California, Davis. This excellent study and report went into

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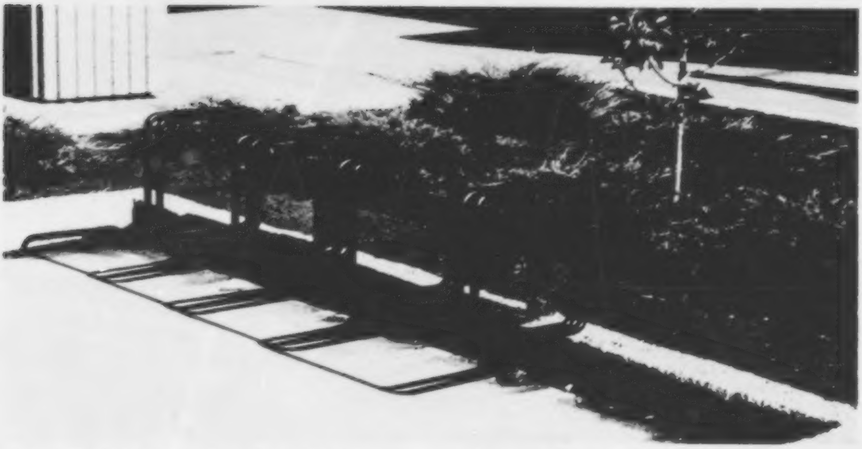
[4] J. A. Gabe, Physical Plant Administrator, University of California, Santa Barbara, Letter to Author, 11 December 1976.

[5] University of California, *Bicycle Book*.



A good-looking bicycle rack and landscaped area in downtown Provo, Utah.

great detail on most all phases of the bicycle problem as it related to the city and university. The following is from that report:

*The City and University bikeway system is an impressive network. However, several additions to the network are needed to achieve the objective of providing community-wide bike access equal to or better than that afforded the automobile.*[6]

The report noted that a mild climate, level terrain, and wide streets enabled the cycle to play a major transportation role, but that probably the most significant element in maintaining the cycle as a viable form of transportation has been the attitude of Davis residents and city officials and the provisions they have made to insure that cycles are not crowded off city streets by growing automobile traffic.

The experiences of the two California universities at Santa Barbara and at Davis and what they have accomplished to facilitate cycle movement might well be what other schools will find desirable and expedient.

The De Leuw, Cather, and Company report contains the following paragraph, which seems to sum up the reasons for action and some of the major elements in the Davis system:

*As the city and university underwent a rapid expansion in the early 1960's, increased traffic accentuated the conflict between bikes and motor vehicles.*

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[6] De Leuw, Cather, and Company, Engineers and Planners, San Francisco, Joint Report Submitted to City of Davis, California, and University of California, Davis, 31 August 1972.

Bicycle stands, Utah State University.

*It became apparent that because of their differing physical and operational characteristics, bikes and motor vehicles were not compatible in sharing street space; and if the unequal competition between the two were not eliminated, the bicycle and with it the unique character of Davis would disappear. In response to this challenge, concerned citizens of Davis introduced to this country the concept of on-street lanes exclusively for bicycles. This concept, adopted and implemented by the city in 1966 has led to the creation in the city and on the U.C. campus of an area-wide system of special bicycle facilities, including on-street lanes, separate pathways, grade separations, streets closed to motor vehicles and greenbelt trails.*[7]

*An ever-expanding network of bicycle paths has been developed on the campus to handle the flow of traffic. Major paths from living areas and from campus access points funnel traffic into the heart of the campus. Not only are paths utilized but also the roadways within the central campus, now*

The following eight photographs of the University of California, Davis, were taken by Michael B. Chandler, Fire Specialist, UCD Fire Department. Acknowledgment is made of the time and effort spent in assembling information by Gino J. Celoni, inspector-planner-estimator, Department of Physical Plant, UCD.

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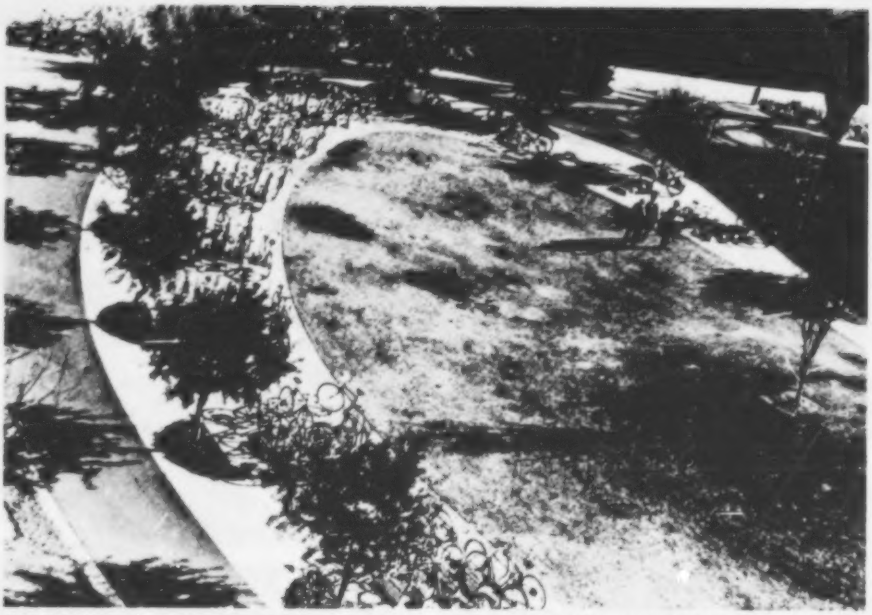
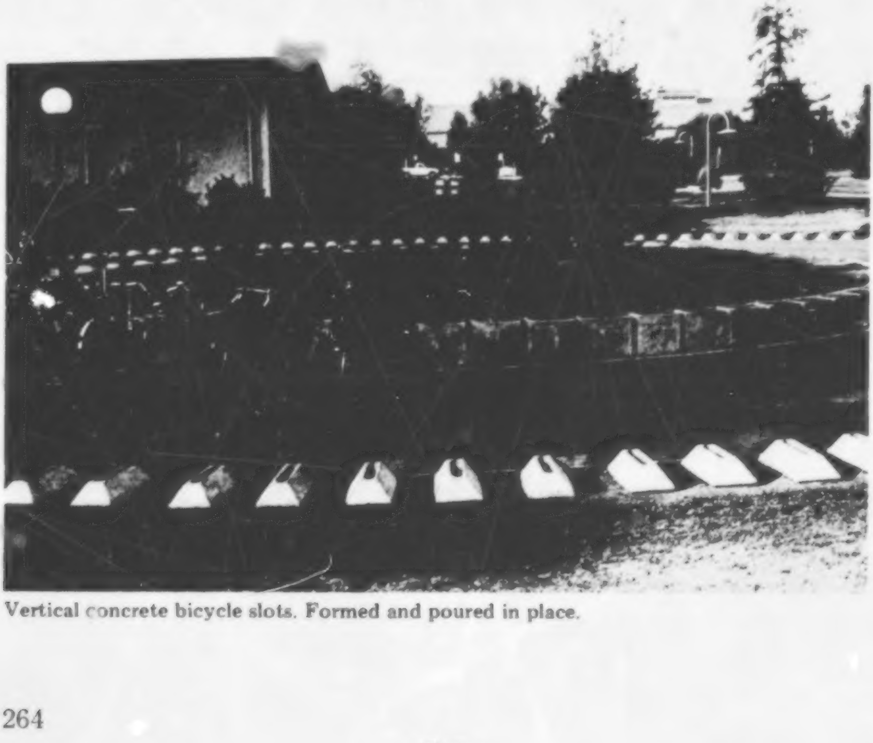
[7] De Leuw, Cather, and Company, Joint Report.

Bicycle/vehicular traffic circle, California Ave./Hutchison Drive intersection.

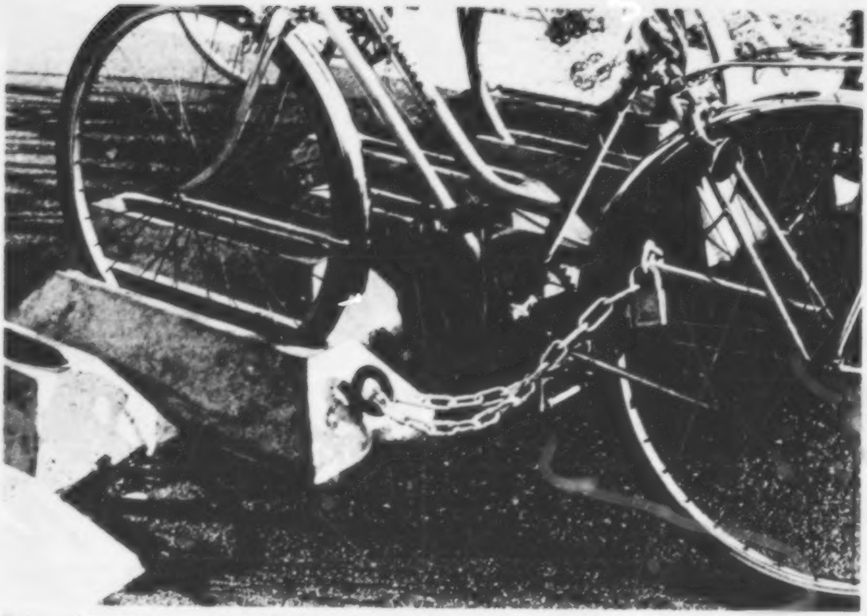
Ground-level view of same bicycle traffic circle.



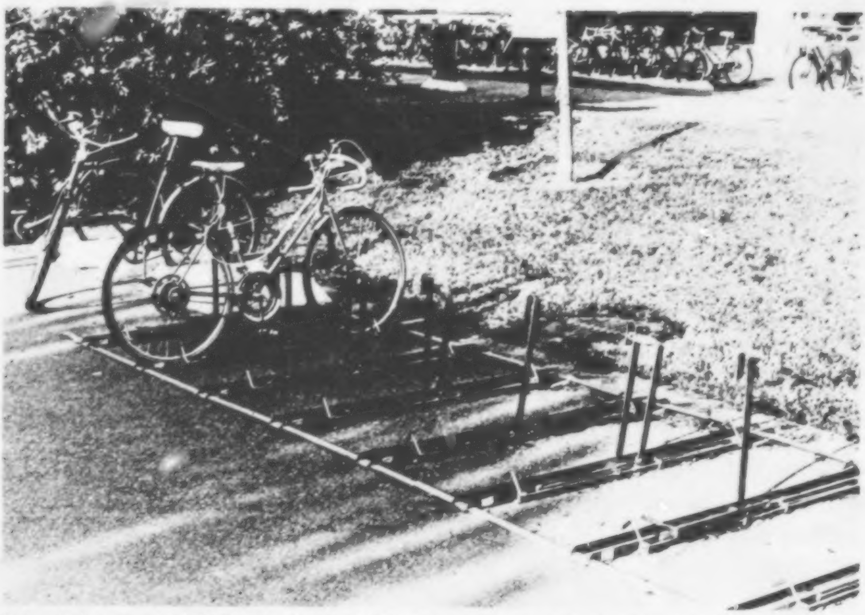
Aerial view of a segment of bicycle circulation pathways. Exemplifies the incorporation of bicycle parking areas into landscaping design.



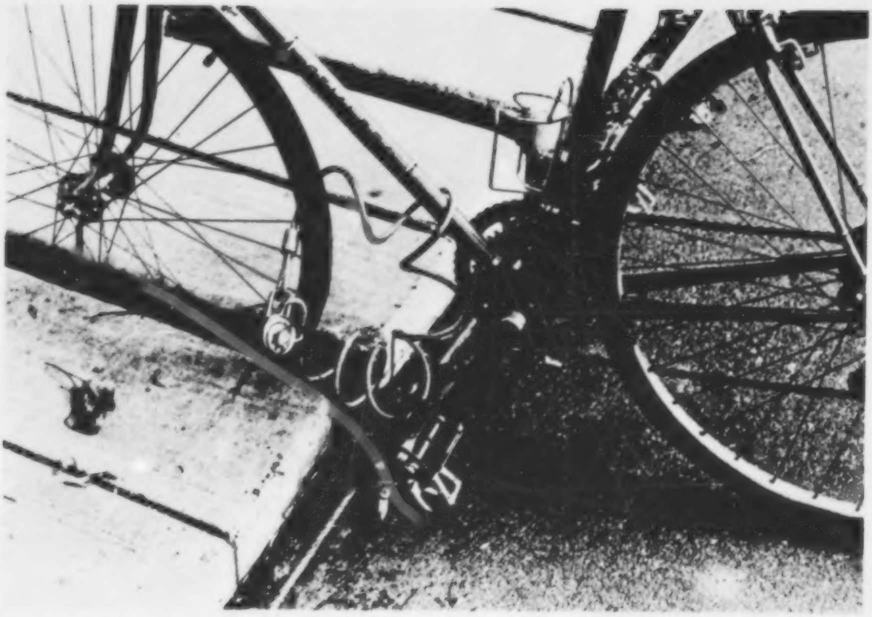
Vertical concrete bicycle slots. Formed and poured in place.



Precast bicycle pod with locking ring.



Patented commercial bicycle stand with locking devices at both wheels and frame.



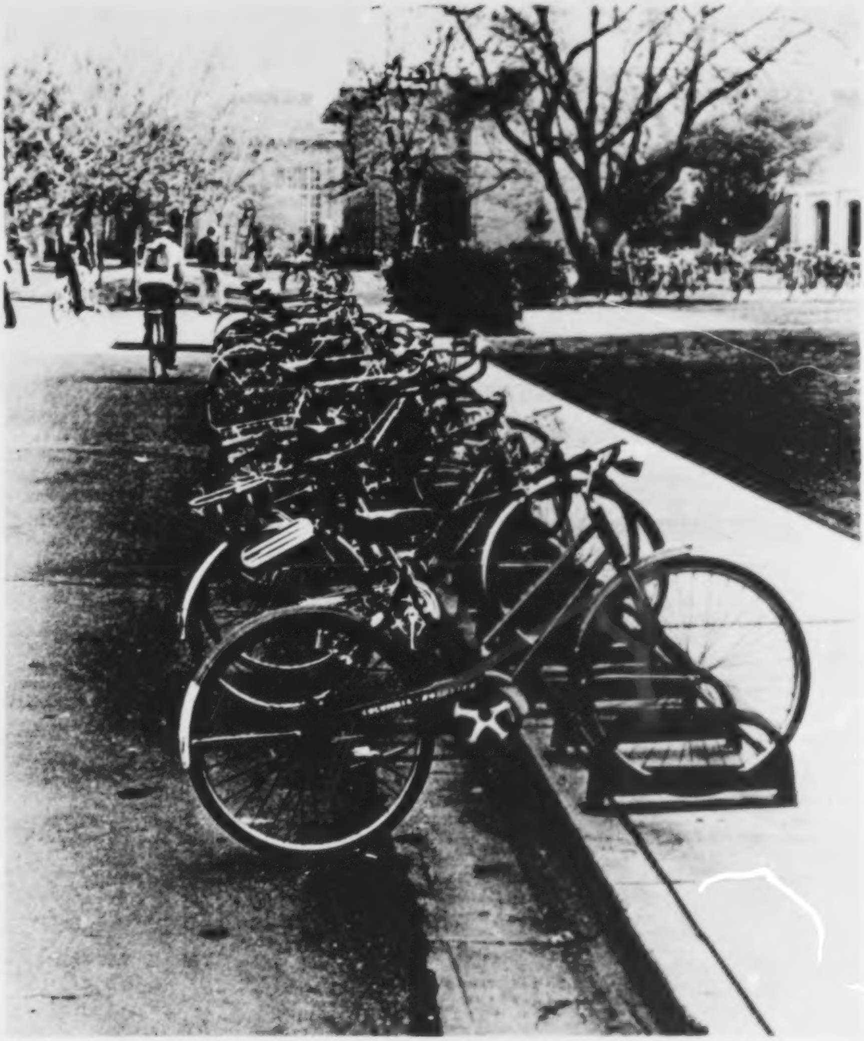
Precast bicycle slots with flexible cable affixed to pavement for securing bicycle.

*abandoned by automotive traffic during class time hours. . . .*

*Grade separations for major auto and bicycle traffic routes are highly desirable. The first of several proposed bicycle undercrossings was constructed with the first increment of the campus perimeter roads. Undercrossings were chosen for use rather than overcrossings since studies indicated that cyclists reject an uphill route. In addition, underpasses are visually more pleasing in the landscape. The original undercrossing is a ten-foot wide undivided path which can also be used by pedestrians. Construction at an 8 percent grade has proven to be too steep a gradient for ease of uphill traffic. A maximum 6 percent grade is proposed for future paths. (A major construction project in the summer of 1975 modified the path grades to 5 percent.) . . .*

*A typical bicycle path is constructed 12 feet wide with a structural section of either three inches of asphalt on grade or two inches of asphalt on four inches of aggregate base rock. If grass or planting areas are juxtaposed to the bicycle path, the path is separated from the landscaped area by redwood headers. (Recent pathways have been constructed with 12" x 4" concrete borders. They are more permanent and seem well worth the price differential.) . . .*

*Although twelve-foot paths predominate within the system, some major paths are as wide as twenty feet. The former are too narrow if they must*



Tubing-constructed low-profile bicycle rack.

*handle pedestrian traffic as well as two-way bicycle traffic. Wider paths can more easily handle both kinds of traffic, but they need a center line. The majority of the paths are lighted. These bikeways for the most part encourage the use of bicycles for the campus population as an alternative means of transportation to the automobile. Heavy use of bicycles has helped reduce car traffic on the campus roadway system and the necessity of building additional parking spaces. . . .*

> *Many lots, exclusively for bicycle use, have been and are currently being developed with new building projects. Existing walks and pathways, as well as street areas once used for automobile parking, are also utilized. It is physically impossible to provide enough bicycle parking facilities in many areas to meet the peak use since there is a limit on distance that bicyclists will park from the building. Students seem more willing to park along pathways in an orderly fashion rather than go any distance out of their way to park in a lot. . . .*
>
> *Bicycle parking as now permitted is a major problem with respect to signing. For the most part, signs are ignored. All signs are designed with positive wording. . . . [S]tudents rebel when the negative is seen. Instead of "No bicycle parking" or "Do not park bikes here," better results have been obtained with such wording as "Park bicycles in lots only" or "Parking at curb only." These signs are low mounted, using a bicycle parking slot as a base. Office-designed graphic signs are used along pathways. These are silk-screened on metal and are mounted seven feet clear above grade on two-inch galvanized metal posts set in concrete.*[8]

The University of California, Davis, Traffic and Parking Code, reads in part as follows: "Parking of motor vehicles and bicycles on the University is limited to specifically designated areas as set forth in Chapters 4 and 7 of this Code. Vehicles or bicycles parked in violation of the provisions of this Code are subject to fines, towing or impounding."[9]

Along with the sudden increase in bicycles came a corresponding increase in all kinds and sizes of motor-driven two-wheel vehicles. Student riders felt they should be allowed to park in any parking lot because, "They don't require much room to park." Faculty complained that the noise from motorcycles operating with open cutouts was disturbing their classes. Automobiles and motorcycles were vying for space on crowded streets, and generally the cyclist was the one who ended up in the hospital or worse. More problems for campus planners!

The task facing school administrators and school planners is how best to serve the pedestrians, the cars and their occupants, the bicycles, and the motorcycles but, at the same time, to prevent their interfering with the primary purpose of a college or university or destroying the beauty and tranquility of its campus.

Fortunately, much has been written on the subject. And there are also consultants and experts who, for a fee, will assist in solving the problems. Occasionally, all that can be done has been done, especially with regard to automobiles. Sometimes it hasn't been too difficult because (1) the problems were recognized while the original campus plan was being formulated, and parking lots, bicycle paths, and pedestrian walkways were planned to complement each other, and (2) there was land and space available to do those things and still maintain an attractive campus.

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[8] Henderson, "Bicycles."

[9] Introduction, Section 4.

In other cases, however, it has been extremely difficult to provide bike paths and close-in parking for autombiles because conditions are crowded or because the school's basic design did not provide for them.

However, much very good work has been done at many universities and colleges, both old and new, with regard to campus traffic problems. Nor is any campus so poorly situated that these problems cannot be minimized. Solving traffic problems is not a job for amateurs, however. That challenge is among the most difficult that a school architect, engineer, landscape architect, or planner has to cope with. Meeting the challenge well makes for a safer, better looking, and more orderly campus. Because each school has a different set of problems and conditions, it is impractical to try suggesting in this book the many possibilities that could be considered. But when the campus planning office needs expert help with a serious traffic problem, the office should by all means retain an experienced consultant. It could be money well spent.

### Campus Security and Safety

**Security.** Security and safety should be household words on every college or university campus. A campus is a regular beehive of activity. It is the home, working place, and gathering place for countless numbers of people—most of whom are good, honest, hardworking individuals grateful to be part of an institution of higher learning. Unfortunately, though, there is always that small campus minority who never seem to be content unless they are bending or breaking a policy, a regulation, or a law. A campus also attracts off-campus crooks. It is chock full of valuable and interesting equipment that is often easily accessible to anyone for the taking, and there is so much coming and going day and night that almost anything and anybody can go unnoticed. As an example, at one school several thousands of dollars worth of band instruments were taken in broad daylight from a building in the center of the campus. Many people saw the truck being loaded and thought nothing about it.

Drug pushers, drunks, sex offenders, peeping toms, thieves, arsonists, vandals, traffic offenders, even murderers are part of the security problems of a university or college. Crime prevention and apprehension are major concerns for all school administrators, especially in view of the constant increase of aggravated and sophisticated crimes.

To minimize such problems requires knowledgeable security personnel, good security equipment, and a campus developed with such problems in mind and a considerable outlay of money.

Robert Kelshaw, chief of Security at Brigham Young University, comments on some of the important aspects of a campus security system as follows:

*To monitor problem areas, consideration should be given to the installation of an automatic call-in alarm system, which is an extremely effective means of monitoring natural or man-made incidents. Should an alarm be triggered as a result of burglary, robbery, intrusion, fire, flooding, power outage, temperature malfunctions, etc., a printout on the "monitor" would reveal the problem area, enabling officers to be dispatched immediately to the appropriate area and oftentimes greatly reducing the total damages.*

*A confrontation and disaster call-out plan flexible enough to deal with any disaster should be devised. In the event of natural or man-made disasters such as explosion, floods, fires, and riots, this plan would include who to notify, what emergency steps to take, and where to locate strategic electrical switches, main water valves, and master key numbers.*

*Particular problem areas on campuses should be analyzed and various methods of surveillance should be utilized. Locker rooms and dressing rooms on every campus seem to be a prime target for thefts. Therefore, campus planners should design and install surveillance areas either by using a two-way mirror located within the locker and/or dressing rooms or by using closed-circuit television cameras that could be monitored by security or locker-room personnel. The utilization of two-way mirrors is the less expensive alternative.*

*An effective, inoffensive method of cautioning individuals to secure their valuables is to display cartoons emphasizing the consequence or dangers of leaving their items unattended. Such cartoons may illustrate the ease with which some articles may be pilfered.*

*Especially important is the need for adequate interior and exterior lighting. To help reduce crimes against persons and property, the campus planner should include appropriate lighting throughout campus, especially in all heavily landscaped or secluded areas. All parking lots should be properly illuminated.*

*A "trouble report" should be used by campus Security to report deficiencies effecting security or safety. Such a report should be designed to provide a quick and easy way of notifying Physical Plant or other university* *personnel of defective equipment, safety hazards, problem areas, and any other situation needing attention.*[10]

The following is the "Trouble Report" used by the Brigham Young University Security Department:

☐ Doors/windows insecure
☐ Defective door, lock, window
☐ Other security conditions
☐ Street lights out
☐ Fire hazards
☐ Street defective
☐ Other safety hazards
☐ Other utility conditions

| | | |
|---|---|---|
| Time | Date | Location |

Description and action taken by Officer

Officer ____________________

Chief Kelshaw further stated,

*As it is often difficult to anticipate a serious campus disturbance, it is imperative that a plan for handling one be carefully worked out in advance. Hopefully it would never be needed, but if needed, it could do much to prevent costly and serious consequences. Campus Security would likely have the major responsibility, but the plan should carefully and in detail outline the responsibilities and courses of action to be taken by other departments, school, staff, and local law-enforcement agencies.*[11]

Safety. Safety on a new campus should begin at the same time the master or site-development plan is started. Safety on an existing campus is a matter of correcting many built-in hazards most of which should never have occurred in the first place. Safety in a new building should start at the beginning of architectural design and should continue throughout the life of the project.

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[10] Robert W. Kelshaw, Chief of Security, Brigham Young University, Statement Prepared for the Author, 1975.

[11] Kelshaw, Statement for Author.

The point is that when unsafe features are planned and built into a campus and its buildings—and it happens often—subsequent discovery (as a result of accidents, injuries, and deaths, or by belated safety surveys) and correction necessitate large outlays of effort and money.

Architects, engineers, and planners should be very much aware of and knowledgeable about safety standards and requirements. School officials should also be aware of the importance and necessity of campus safety, and they should require that their consultants and school staffs plan accordingly. At the same time, the school should also be willing to provide the financing necessary for an adequate job.

A list of things that should be considered during the planning stages could be a long one. Certainly those things dealing with fire detection and prevention should be high on the list. It is generally conceded that crooks, muggers, and exhibitionists prefer darkness over light to conduct their business. Thus, a well-lighted campus with as few unlighted corners, underpasses, shrub masses, lawn areas, and spaces around buildings as possible is a good investment. Accidents caused by tripping, slipping, "falling over," and "falling in" are common, and things that contribute to them should so far as possible be eliminated. Accidents occur because of inadequate electrical designs and installations. Too few circuits and the resultant overloading have caused many problems. Inadequate, poorly designed, and poorly lighted stairways and steps have been the cause of many nasty falls.

Emergency lighting is definitely a safety item of first importance. It isn't too unusual to have a power failure affect all or parts of a campus several times in a year. It is hard to imagine a worse situation than having a building full of people at night when all lights suddenly go off and there isn't so much as a flashlight available. All someone would have to do is yell "fire"; the resulting stampede could be disastrous. Even the orderly exit of people from a large, multistory building can be a harrowing experience if done in total darkness.

There are different kinds and types of emergency lighting equipment on the market. The selection of a unit or units could be made based on (1) the amount of light felt to be necessary, (2) the performance records of the equipment being considered, (3) original cost, (4) future operating and maintenance cost.

Where emergency lights would be installed would depend somewhat on the building and its use. But emergency lights should certainly be installed in corridors, stairwells, and large assembly rooms, in all exits, and in critical spaces such as first-aid rooms and operating rooms.

Of course, it isn't always possible to protect an individual if he seems intent on hurting himself. Consider this example: A contractor at a university was installing a storm sewer. The trench was approximately eight feet deep, and the dirt from the excavation was piled some ten feet high on one side. On the other side, where no dirt had been placed, the contractor put out a barricade and red flasher lights. A student going to work before daylight climbed up and over the dirt bank and fell into the open trench. The contractor was accused of not taking proper precautions. No one thought to accuse the student of walking around in his sleep.

Often when a careful safety survey is made of existing buildings, many of the hazardous items noted are the result of poor departmental housekeeping—boxes of books or paper stored high on filing cases, combustibles improperly stored, extension cords stretched across the floor, equipment improperly installed by department personnel, and dozens of other items that constitute hazards but are easily corrected by personnel in the departments without outside help. On the other hand, building and grounds surveys will also uncover scores of things not so easily or economically corrected. Sometimes plans must be drawn and contracts let. Most often the Department of Physical Plant can do the work; but when the list of items to be corrected is very long, it may be necessary to supplement the regular Physical Plant crews with additional personnel if the needed work is to be completed within a reasonable time.

Schools that already have a safety program and personnel to administer it can make the needed surveys fairly easily. A school without a safety program should establish one and employ a full-time qualified man to administer it. Failure to recognize that there are many safety problems on every campus will result in costly and serious accidents and could also mean substantial fines from OSHA.

Keeping a construction project clean and free of hazardous rubbish has always been a problem. Getting workmen to use goggles and safety shoes and to observe posted safety regulations has also been a problem. Thousands of eyes and fingers have been lost—and many lives—because of carelessness or disregard for good safety precautions. In any one year, the work hours lost because of accidents are tremendous.

While most schools, and the construction industry, have emphasized safety, accidents continue. Eventually, in 1970, when the situation had become critical, Congress passed a law known as the Occupational Safety and Health Act (OSHA), and on April 28, 1971, as provided by the act, OSHA became an official part of national labor law.

Almost from the beginning it has been a controversial law. However, it is hard to find fault with the stated purpose of the Act, which is "to assure so far as possible every working man and woman in the nation safe and healthful working conditions and to preserve our human resources." That OSHA meant business, several schools found out soon and at considerable expense. There can be no question but that it has directly or indirectly been responsible for improving safety conditions at every college and university in the country.

The following "Occupational Safety Check Sheet" (authorship unknown), or something similar, would facilitate the work of school safety inspectors. If such a checklist is used properly and regularly, and if adequate measures are taken to correct unacceptable items, the safety conditions of the school could approach compliance with OSHA regulations.

### Occupational Safety Check Sheet

Department____________________

Date ____________________ Building ____________________

| Acceptable | Not Acceptable | | Suggestions for Improving Conditions |
|---|---|---|---|
| | | **Condition** | |
| | | 1. General Housekeeping | |
| | | 2. Aisles maintained | |
| | | 3. Ingress-egress adequate | |
| | | 4. Lighting | |
| | | 5. Ventilation | |
| | | 6. Parts properly organized & stored | |
| | | 7. Wash or steam rack equipment<br>a. Condition<br>b. Area clean | |
| | | 8. Paint section up to standards | |
| | | 9. Pressurized cylinders secured | |
| | | 10. Adequate trash receptacles for oil rags | |
| | | **Handling and Storage** | |
| | | 1. Fuel: Gas Diesel | |
| | | 2. Oil | |
| | | 3. Solvents: Type | |
| | | 4. Acids: Type | |
| | | 5. Paints | |
| | | 6. Chemicals: Type | |

| | | | |
|---|---|---|---|
| | | **Protective Equipment** | |
| | | 1. Safety glasses, goggles, or shields provided where needed | |
| | | 2. The following provided and used where necessary:<br>a. Gloves<br>b. Aprons<br>c. Boots<br>d. Respirators<br>e. Ear plugs<br>f. Other | |
| | | 3. Flash shield used around arc welders | |
| | | 5. Adequate ventilation | |
| | | **Hand Tools (Manual and Powered)** | |
| | | 1. Grounding system used on electric tools | |
| | | 2. Handles in good condition | |
| | | 3. Mushroom striking heads | |
| | | 4. Wrench jaws in good condition | |
| | | 5. Other tools or equipment in good condition | |
| | | 6. Ventilation and hoods on grinders | |
| | | 7. Safety shield and tool rest on grinders | |
| | | **Machine Guarding** | |
| | | 1. Are machines, V-belts, and power trains all properly guarded? (Including grinders, saws, jointers, planers, drill presses, etc.) | |
| | | **Record Keeping** | |
| | | 1. Posters by time clocks | |
| | | 2. Up-to-date accident log | |
| | | 3. Supplemental reports on accidents | |
| | | 4. Review of accidents by safety committee | |
| | | **Walk—Work Surfaces 1910.21-1910.37** | |
| | | 1. Guarding floor/wall openings and holes 1910.23 | |
| | | 2. Fixed stairs and handrails | |
| | | 3. Portable ladders | |
| | | 4. Work surfaces | |

| | | | |
|---|---|---|---|
| | | 5. Stairways for general egress 1910.37 | |
| | | 6. Aisles marked and maintained | |
| | | **Power Platform Equipment 1910.178** | |
| | | Fork Lift Numbers: | |
| | | Fuel Used: | |
| | | 1. Fuel is stored | |
| | | 2. Units are fueled by: | |
| | | 3. All fork lift operators trained | |
| | | 4. No one allowed to stand or pass under elevated portion of fork lift | |
| | | 5. Parked for lift—controls neutral—power shut off—key or connector removed—forks on surface | |
| | | 6. Overhead guard on fork lift | |
| | | 7. Only loads within fork-lift capacity handled | |
| | | 8. Unsafe fork lifts put out of service | |
| | | 9. Engine shut off when fueling | |
| | | 10. Fork lift inspected at start of shift | |
| | | 11. Fork lift clean and free of grease or leaks | |
| | | **Environmental Control 1910.94 1910.41** | |
| | | 1. Noise exposure | |
| | | 2. Sanitation and toilet facilities<br>a. Clean<br>b. Water closet each sex<br>c. Paper and holder<br>d. Covered receptacle—women<br>e. Door and hanger on each water-closet stall<br>f. Hinged, open-front seat | |
| | | **First Aid 1910.151** | |
| | | 1. First-aid kit stocked with approved supplies and readily available | |
| | | 2. List showing phone numbers for company doctors and ambulance posted | |
| | | 3. Employees trained to render first aid | |
| | | **Fire Protection 1910.144 1910.156** | |
| | | Portable fire-extinguisher protection | |

| | | | |
|---|---|---|---|
| | | Sprinkler fire protection | |
| | | Fire-hose protection | |
| | | 1. Visual marking of portable extinguishers in red | |
| | | 2. Visual marking of portable extinguishers by Group "A" "B" "C" | |
| | | 3. Extinguishers mounted on hangers<br>a. Top of extinguisher not more than 5 feet from floor<br>b. Inspection tag attached<br>c. Inspected yearly | |
| | | 4. Sprinkler fire protection—marked in red and signs on valves | |
| | | 5. Access to extinguishers and sprinkler valves clear | |
| | | 6. Housekeeping—"No Smoking" signs where needed | |
| | | Material Handling and Storage 1910.176 | |
| | | 1. Storage of chains, cables, pry bars | |
| | | 2. Storage of ladders and rug extensions | |
| | | 3. Storage of dunnage | |
| | | 4. Trash receptacles and general trash container adequate | |
| | | Electrical 1910.308 | |
| | | 1. General wiring in good order | |
| | | 2. Switches, plugs, extensions in good order | |
| | | 3. Portable tools and equipment grounded | |
| | | 4. Circuit box covered and marked | |
| | | Other Problems | |
| | | | |

Name of Inspector ____________________

Distribution

## Summary

Bicycles and two-wheel motor vehicles have created problems for campus planners and campus security that were largely unknown a few years ago. It appears that they will continue to increase in numbers. Half-hearted attempts at solving the problems they create may not be sufficient. Schools should plan not only for an immediate solution; they should also anticipate and plan for future increases.

Campus traffic and safety is of major concern to all school administrators. Heavy traffic and all forms of crimes from petty larceny to murder are too common on most campuses. To minimize such problems requires careful planning, knowledgeable security personnel, good security equipment, and a sizable budget.

# 15

# The Physically Handicapped

"One out of every ten children in the United States—roughly seven million—is handicapped. But only 40 percent are receiving any education at all, and more than two thirds of those who are in school are not getting an education appropriate to their needs."[1]

"In the past, architects have been content when the buildings they designed have functioned satisfactorily with respect to 'the average man.' Unaware of the large number of the physically handicapped striving to make their way in the world as functional and productive citizens, architects have often inadvertently designed and built into their buildings elements that act as environmental restrictions to the handicapped."[2]

*There are no "keep out signs.' None are necessary. Twenty steep steps lead to the library door. Curbs are high. The only elevators are for freight.*

*These obstacles—insurmountable to a student in a wheelchair—prevent many capable people from going to college and also dictate what institutions others will attend. Of the more than 2,000 U.S. colleges and universities, there are fewer than 300 to which the physically handicapped, no matter*

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[1] Bernadette Doran, "Handicapped Students," *Nations Schools and Colleges*, March 1975, pp. 33-41.

[2] "Making Facilities Available to the Physically Handicapped," Published by the State University of New York Construction Fund (Albany, New York, 1967).

**Where ground-level entrances to buildings do not exist, access ramps facilitate travel for** physically handicapped individuals. Ramp widths must be a minimum of 4' with a maximum slope of 8.33%. Ramps with over a 5% slope require a handrail. Handrails should be continuous, smooth, 32" high from the surface of the ramp, and should extend 1'0" beyond the top and bottom of the ramp.

*how keen their minds, can apply. Estimates place the number of wheelchair students attending these colleges at roughly 500. Hundreds, perhaps thousands, of others do not because campuses are too difficult to get around on.*[3]

"The design of most schools says 'keep out' to physically disabled students. Yet with minor modifications, schools could easily bid 'welcome' to the handicapped—and open up a whole new world to them. Some schools and colleges have been quite progressive in providing proper facilities for mainstreaming handicapped students. It would serve us well to imitate these schools. In fact, the law demands it."[4]

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[3] "Students on Wheels—How to Adapt a Campus for the Handicapped," *College Management*, December 1967, pp. 21-27.

[4] James R. Russo, "Mainstreaming Handicapped Students," *American School and University*, October 1974, pp. 25-32.

"People in wheelchairs are faced with many handicaps. They cannot walk in the front doors like you and I. Makeshift ramps at front entrances have to be climbed, and hopefully, some kind student will take the time to open a massive front door for the wheelchair student. In most cases, they have to navigate the most devious routes just to get into a building, sometimes through underground tunnels and basement areas."[5]

Those five opening quotes from a fine publication by the State University of New York and from four excellent magazine articles just about perfectly state the problem. They are all well-written publications full of good details, and they teach just about all that it is necessary to know on the subject of providing physical facilities for the handicapped. The intent of this brief statement on the subject is not to provide details but to pinpoint the problem and to emphasize the necessity of doing something about it. Any interested school official could use the material found in the above-quoted references and from them could develop a program for helping the handicapped students at his school. This would bring rich rewards to the school and to the students.

Many colleges and universities now recognize the problem and are doing something about it or are planning on doing something. Students in wheelchairs, both manually and electrically propelled, are common sights at a rapidly growing number of schools. And the student with a white cane or a seeing eye dog is likewise an increasingly common sight on campuses today. Entrance ramps have been built alongside the steps to many libraries and other campus buildings. Ramps have been, or should have been, built over curbs to facilitate both wheelchair and bicycle passage. But all this is only a beginning; there is much more to do. Unfortunately, in older buildings, the solutions to problems of providing vertical lifts, satisfactory restroom facilities, and other necessities have been slower in coming because of cost and construction problems.

It is difficult to know how many colleges and universities that have constructed major facilities in the past few years have gone all out to provide properly designed and adequate facilities for the handicapped. But the list probably would be both impressive and encouraging. Certainly handicapped students deserve all that can be done for them. No students on any campus are more uncomplaining, more self-reliant, determined, and deserving than the handicapped.

If the facilities for the handicapped are included in the plans and specifications for a new building, the extra cost, percentage-wise, will be very little. If

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5. John C. Gardner, Director of Buildings and Grounds, Columbia University, "Help Eliminate Architectural Barriers," *American School and University*, October 1974, pp. 34-35, 38.

Especially important where large numbers of physically handicapped individuals gather are accessible restroom toilet facilities. A minimum 32" clearance at the door opening is required. The door must also swing outward for ease of access. Handrails approximately 52" long on both sides of the stall are preferable. The stall must be a minimum of 5' in width and 4'9" in depth. A wall-mounted toilet is suggested to allow approach of wheelchair footrests to the toilet seat.

such facilities are provided in an old building which is completely lacking in facilities for the handicapped, the cost will be greater; but where else could money be better spent?

It is recommended that every school retain someone on its staff, either full-time or part-time, who has the responsibility for counseling with disabled students and representing them at all levels while they are in school. These individuals would become authorities on the physical needs of the handicapped and would see that their needs are included in all "building programs" for new buildings. They should critique all building plans in preliminary and advanced working-drawing stages to see that the architects and campus planning staffs have made ample provisions for the handicapped. These counselors should work closely with school architects and with their departments of Physical Plant to see that adequate facilities are provided in the older buildings and on the campus grounds.

Disabled students should serve on planning committees for physical facilities because they, better than anyone else, know what their needs and requirements are.

The handicapped student needs help, but not sympathy, and the nation needs the contribution that these extraordinary people are capable of making. The place to get it all together is on college and university campuses.

## Summary

There are perhaps seven million young people in the United States who are handicapped. Many will be denied an opportunity for a good education, because too many schools have not recognized and provided for their specialized needs. Many disabled persons deserve and are qualified to attend an institution of higher education. If afforded that opportunity, most would graduate and make useful and productive lives for themselves. Modifications of existing facilities to adequately meet the requirements of the disabled person are not always easy, and often they are quite expensive. However, the need is great, and all schools should prepare comprehensive plans for meeting those needs and should accomplish them as fast as finances permit.

# 16

# Energy Conservation

There is no reason to believe that fuel and energy shortages will just go away. On the contrary, it looks as though the situation will get a lot worse. As a consequence, all schools should do as much as possible to reduce the use of all forms of energy. Universities and colleges in general have taken this problem seriously, and many campuses have achieved some rather remarkable savings. Most schools have discovered that they have been extravagant in the use of electricity, that with a little planning, they could conserve, not only electricity, but also money.

By this time, practically every university and college has developed its own program of energy conservation. Most have discovered that a big saving in electrical consumption comes from shutting down pumps, motors, and fans when they are not needed. Some schools have central control systems that provide the ability to cut off heavy users of electric power at designated times. Where central control systems are not available, the peak reductions have had to be made manually. Time clocks have also been installed to permit cutoff of equipment when their operation is not necessary. Surveys have been made to determine actual light requirements; as a result, lighting intensities have been greatly reduced.

*Most universities feel that a three phase approach to the problem of energy conservation is the most practical. The first phase would include those items that can be done with relatively small expenditures and show immediate* *results. The items to be considered in the first phase are those that can be accomplished by the university personnel and mainly involve the cooperation of the faculty and student body. Phase 2 would include items that require modifications by outside contractors and therefore require engineering help, either from the university staff or outside consultants. This would include items such as modifications to air conditioning systems to reduce the amount of fresh air or to provide heat recovery of exhaust air, modification of system controls to obtain more efficient operation, etc. Phase 3 would involve items of major capital expenditure that would require advance planning and budgeting. Examples of such items would be installation of central campus automation systems, conversion of chiller systems to heat pump systems, etc. These items usually would require an outside consultant to make the cost estimates and estimate the payback period and cost effectiveness of such major investments.*[1]

As a result of all the work that has been done in energy conservation at schools throughout the country, one major discovery has been made: schools can greatly reduce their use of electrical energy without seriously affecting normal school activities. Accomplishing maximum savings, however, requires professional guidance and the cooperation of school personnel. Some schools have employed professional engineers to work with their own staffs in surveying their mechanical and electrical systems to determine where and how savings could be made. Most schools have utilized their own personnel and have developed their own programs for energy conservation.

An adequate program consists of more than unscrewing light bulbs, shutting off lights when not needed, and dropping temperatures in buildings a few degrees. Those are important and highly worthwhile parts of a coordinated program of energy conservation, but one fifty-horsepower electric motor running when it isn't needed can offset the savings made by turning off many lights when they are not needed. (A fifty-horsepower motor opoperating at full load for eight hours would consume 400 kilowatt-hours of electricity—the amount of electricity required to operate 500 hundred-watt incandescent bulbs for eight hours, or 1,250 forty-watt fluorescent tubes for eight hours.) There are many such motors on a sizable campus where heating and cooling are provided, and often they run when there is no need for them. This is where professional engineering guidance is required—to determine when motors, pumps, and fans can be shut down, and the most effective and economical way of shutting them down. Certainly controls that accomplish this and help prevent electrical peaks, which often result in increased power bills, should be investigated. If a school does not have qualified mechanical and electrical engineers available, it should employ qualified outside professional engineers to complete the needed surveys and make recommendations.

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[1] Frank H. Bridgers, Bridgers and Paxton, Consulting Engineers, Inc., Albuquerque, New Mexico, Letter to Author, 9 June 1975.

Potential savings exist on every campus, and it is in the interest of all concerned to see that electricity, gas, coal, and water be used wisely and conserved to the extent that it is possible and practical to do so.

*When energy considerations were not so significant as they are now, personnel comfort and ease of control were prime considerations in designing an air-conditioning system. This prompted the use of constant volume double duct and reheat type control systems which have proven to be very expensive to operate, with some of the highest expenses being incurred during nighttime hours and weekends when the buildings were unoccupied. For example, in one building having a total floor area of just under 300,000 gross square feet, it was determined that the cost of supplying heat and cooling for temperature control during the summer months at times when the building was largely unoccupied (approximately 8 hours each night and all day Saturday and Sunday) was in excess of $3,000 which included electricity to the fan motors. Since the advent of the energy crisis, many buildings are being initially designed with a variable volume type temperature control which eliminates the need for the constant volume mixing boxes, or reheat type control in most areas. This system, while somewhat lacking compared with the higher energy consuming type systems insofar as personnel comfort is concerned, produces significant savings in energy and operating costs. . . .*

*In many air-conditioning systems involving the use of large amounts of outdoor air, it has been determined that as much as 60 percent of the energy has gone into heating or cooling the outdoor air. Recent studies in this regard have shown the need for significantly lesser amounts of outdoor air. The latest recommendation of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers calls for outdoor air at 5 cfm per person compared to 10 to 30 cfm per person previously recommended. . . .*

*Surveys of personnel comfort with respect to outdoor air in buildings have indicated that personnel comfort is much more related to temperature than to the amount of outdoor air, and people who have considered their area somewhat "stuffy" or lacking in air at 76° F to 77° F have, with the same air flow, felt noticeably drafty at 68° F to 70° F; therefore, it leads us to the conclusion that a combination of air flow and temperature can provide comfort conditions over a much wider range than heretofore thought practical.*[2]

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[2] William C. Stacey, Mechanical Engineer, Department of Physical Plant, Brigham Young University, Statement Prepared for Author, 1975.

*In some cases when large amounts of outdoor air is required, such as for science buildings where make-up outdoor air is required for laboratory hood exhaust, it is not practical to reduce the outdoor air quantity. In these cases, an analysis should be made to recover the heat in the exhaust air for preheating the outdoor air make-up by means of "run-around coils" or exhaust air heat recovery heat exchangers. . . .*

*Control-system and operating procedures are now proving to be a major source of energy conservation within buildings. Such proven energy-conserving automatic-control procedures as (1) programming the starting and stopping of large motors (fan systems and chillers can be shut down at nights or on weekends or whenever the building is not occupied), (2) resetting control set point of hot water for radiation, hot deck, cold deck with outside air temperature, and (3) electrical peak shaving by shutting off nonessential motors and other heavy consumers of electricity when the demand approaches a previous peak—a method that can readily be incorporated into a central campus-automation system."*[3]

Without making any effort to list them according to importance, or in any logical sequence, the following are items and ideas that seem to be worthy of consideration.

1. Reduce thermostat settings in the winter months, and increase them in the summer time. However, in some cases, reduction of temperature thermostat settings for interior spaces that have a large internal lighting load can increase energy requirements if the space is cooled by refrigeration systems. Many campuses operate campus refrigeration systems on a year-round basis and depend on year-round air conditioning to provide the necessary interior zone cooling in winter time.
2. Every light on campus should be turned off when not in use. (It has been debated as to whether or not it is more economical to turn them off, but it appears that the affirmative has it, that they should be turned off.)
3. Light in rooms should be reduced to the lowest levels that will not adversely affect the occupants.
4. Electric portable heaters should not be allowed except where no other heat is available. (These small space heaters are heavy users of electricity.)
5. Reduce temperatures in unoccupied dormitories to as low as 50° during holiday seasons. (The same would apply to any other unoccupied school buildings.)
6. Consider reducing the cooling system in buildings beginning an hour or two before closing time.

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[3] Bridgers, Letter to Author, 24 January 1975.

7. Cleaning crews often leave all the building lights on while they are doing their work. They should be instructed to have the lights on only where they are actually working.
8. Lights on athletic playing fields and courts should be closely controlled. (Many times such areas are lighted when they are not in use.)
9. Encourage car pools and the use of bicycles for personnel and students. Encourage people to walk.
10. Require that no school vehicle be driven faster than 55 miles per hour.
11. Be careful in the use of hot water. Reduce temperatures to 110° F in all academic and office buildings. Only in residence halls and food services should control settings be maintained at the normal 140° or 180° level. Keep faucets and valves repaired.
12. Provide as much insulation as possible and wherever possible.
13. Prevent air leaks by proper sealing and caulking.
14. Compartmentize buildings so that areas not being used can be taken out of service.
15. Encourage architects and engineers to become familiar with new materials, methods, and techniques being developed by industry. This requires additional effort on their part. Of course, one should not take new materials or designs at face value.
16. It is suggested that the architects and engineers file in the appropriate design stage (possibly the preliminary stage) a statement of expected operating costs. If several systems are to be considered, their operating costs ought to be evaluated at the same time.
17. Give real emphasis to *preventive maintenance*. Determine leaks in existing or new facilities by checking the rate of water flow between the hours of 2:00 a.m. and 5:00 a.m. In a new building, there should be no flow of water. In an old building, it should be very minimal. If excessive water is flowing, find where it is leaking and make corrections.
18. Check existing appliances, examine the specifications for new appliances on the rate of water and power consumption. Some are much more efficient than others.
19. Control oversprinkling of lawns during the sprinkling season. This is a major item in the use of water. It is sometimes detrimental to the lawns and often causes water to enter the buildings. An inexpensive moisture probe will indicate how much moisture is in the ground.
20. Check all facilities for open doors or windows during the heating or cooling season and determine why they are open. Take corrective measures.
21. Check all thermostats for proper calibration.
22. Insulate hot-water pipes and air-conditioning ducts.
23. Install storm windows or insulated glass. These will pay for themselves in climates having more than 4000 degree-days annually.

24. Educate occupants in the proper use of drapes. In the winter, close drapes at night. They are good insulation. Open them in the daytime, when the sun is shining, to gain solar heat. Reverse the process where practical in the summer time.
25. Use better quality doors and windows with weather stripping.

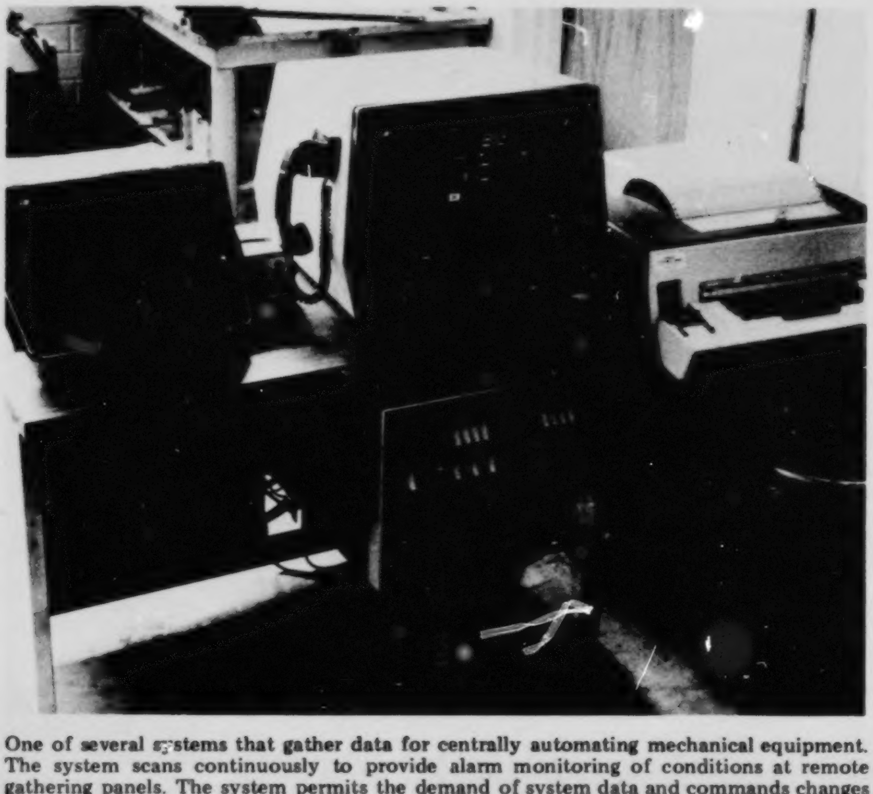
Here are a few items that might be considered if the situation gets to the point where even more drastic steps should be taken:
1. All outside lights not needed for safety and security could be turned off. This would include floodlighting of all kinds.
2. Eliminate Christmas tree lights.
3. Close down fountains where they are operated by electric pumps. (At one school it was estimated that this would save enough to supply the electrical requirements of four average homes.)
4. Physical Plant operations and other functions that would permit might go on an 8:00 a.m. to 4:30 p.m. schedule with a one-half hour lunch period. (This would cut one half hour from the time that office and shop areas would require lighting, heating, and cooling.)
5. Purchase compact cars for school use, and use car pools for school travel whenever feasible. (There is a strong possibility that in a few years, small cars will be about all that is available.)
6. Do not schedule night football games. However, people at football games are not using home lights and television sets, so the difference in the use of energy might be small. The net energy used by people watching television in their homes could be as great as or greater than the amount of energy used to light the football field.

The above suggestions might be implemented in an existing plant. In-depth studies by qualified engineers at individual schools will develop additional ways of conserving energy. By following a good program of energy conservation, a school will not only help relieve the nation's energy problems, but it can also save itself a considerable sum of money.

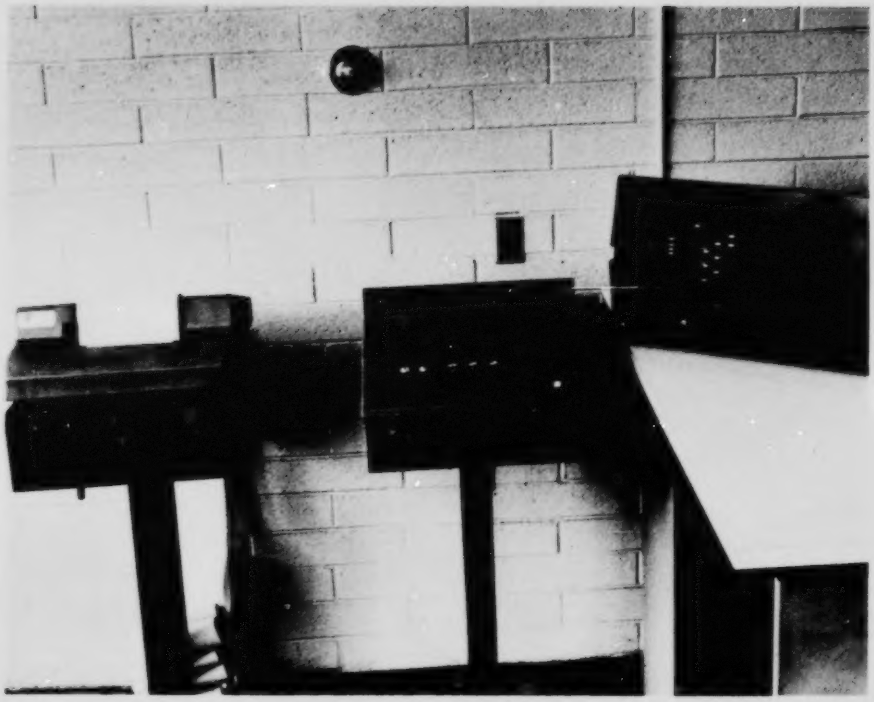
In planning new buildings, school officials, architects, and engineers should consider carefully any ideas or devices that could possibly reduce energy demands. In the past, it has been more or less taken for granted that electricity, gasoline, and natural gas were available in whatever amounts were needed; and their use was determined more by economics than by the need to conserve. That situation has changed. Certain energy-producing resources are in critical demand, and it behooves every builder to take that fact into consideration when he is planning new facilities. What can be done to reduce the energy requirements of new buildings will vary depending on the structures, their location, and their function. As noted above, much study and thought is being given to the subject. School officials should insist that their architects and engineers have current knowledge of the best information available and that they give full consideration to all possible energy-saving measures when designing new facilities.

*Cube-shaped buildings with little fenestration are obviously energy savers. Also, buildings having their long axis running east and west require less cooling energy than those whose long axis runs north and south.*

*Aside from building configuration, the energy-systems designer should be involved in the early planning stages to correlate such things as insulation, fenestration, duct spaces, and lighting with the heating-cooling system. A computerized analysis of the building energy requirements, and evaluation of various systems which will meet the requirements, will usually result in*



One of several systems that gather data for centrally automating mechanical equipment. The system scans continuously to provide alarm monitoring of conditions at remote gathering panels. The system permits the demand of system data and commands changes in operating conditions. With this and similar equipment it is possible to monitor from a central point the operation and adjustment of equipment in distant locations. Indicating lights show "normal" and "alarm" status. Motors and fans may be started and stopped automatically at predetermined times. This particular system is computerized.



A high-speed, half-duplex serial-transmission system to gather data for centrally automating mechanical equipment. With such a system all connected equipment can be kept under constant surveillance. If anything goes wrong, the system will pinpoint the exact location, facilitating instant attention. Fans, pumps, chillers, and motors can be programmed to start and stop at any predetermined time. Lights can also be automatically controlled if properly programmed. In fact, such systems can be programmed to do almost anything. The system shown here is not computerized, but computerized systems are available. Such systems are proving to be a major source of energy conservation within buildings.

*substantial savings in both capital investment and operating costs. There are several firms which now offer this service to design engineers.*[4]

Many energy-saving items should be considered in planning new buildings, but here are three that certainly should be given serious consideration:

1. The number, size, and location of windows should be carefully studied. They are prime sources of heat loss in the winter time and of cooling loss in the summer time. Windows are used more for aesthetic and architectural

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[4] Lloyd G. Soderborg, Mechanical Engineer, Department of Physical Plant, Brigham Young University, Memorandum to Author, 5 February 1975.

reasons than for practical reasons; but building occupants will continue to demand them, and architects will continue to use them. It is recommended, however, that excessive use of windows and large expanses of glass be eliminated and that thermopane glass be used throughout where windows are required. Tinted glass should also be considered. Where excessive windows and glass are used, the air-conditioning systems must be greatly enlarged, resulting in higher initial cost, higher operating and maintenance costs, and a corresponding increase in the use of diminishing energy resources.

2. Serious thought should be given to installing automatic controls that would shut off heavy users of electricity, such as motors, fans, and pumps, at predetermined times. It is wasteful and expensive to keep them running when they are not needed.
3. Light levels should be carefully studied. Light intensities have climbed steadily over the years. Foot-candles of illumination in offices, corridors, elevators, parking lots, and elsewhere on campuses are often two to three times higher than needed.

Groups all over the country are pooling their ideas on ways and means of conserving energy; books are being written on the subject. (This chapter can be considered only a brief introduction to the subject.) As time goes on, federal and state regulations will get tougher. And the waste or extravagant use of natural and nonrenewable resources, as practiced in this country for so long, is going to be brought under stricter controls.

*School people, as all others, are going to be exposed to new and different ways of doing things. New descriptive phrases and words will come into use. Phrases like, "quick fix" (important energy savers that can be fairly easily done at relatively small cost); "refit" (This will involve technical studies and the expenditure of sizable sums; but the savings can be great); "systems convert" (This will necessitate engineering studies and substantial revisions to existing systems).*[5]

Energy conservation is here to stay. Universities and colleges are in a good position to become leaders in the field. By practicing and teaching energy conservation, they will not only be helping solve a national problem, but they will be saving themselves a sizable sum of money each year as well.

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5. NACUBO, APPA, and ACE Task Force, "Energy Conservation—The Capital Investment Needs for Building Rehabilitation for Non-Profit Educational Institutions," Paper 2, 17 April 1975.

## Summary

Critically short supplies of energy will last longer if every university and college in the country will institute a comprehensive program of energy conservation. The "know how" is available; all that is needed is the will. To accomplish a worthwhile program will necessitate an expenditure of funds. But it should be thought of as an investment, because money spent on energy-saving devices will be returned many times over. It should also be recognized that present-day energy problems are largely a matter of economics. In the future, when no amount of money will be able to buy certain energy-producing fuels, the question will no longer be one of economics. As a nation we have failed to accept that as a fact. We are still extravagant in the use of all forms of energy. The enlightened personnel of our universities and colleges should set an example for the rest of the country in the wise use of all forms of energy produced from nonrenewable resources.

# 17

# Instructional Technology

*We can testify that the educational process is now changing, and is going to change even more. We do not know what form it is going to have in future years, but we do know that it is not going to look like it does now. Certainly the lecture has its place, but if we can relieve the teacher of all kinds of drudgery so that he can respond on an individual basis to the student, individualization will become much greater. We know that individual instruction—that is, taking care of a person's individual needs—is the way in which instructional systems are moving. All of our studies indicate this. The University is going to change in its processes and in its utilization of physical facilities. As a matter of fact, the physical facilities are going to have to be modified.*[1]

There is no intention to comment on whether present-day teaching methods and future educational trends are good or bad. However, the above statement is sufficient to indicate to architects and school planners that the components to be considered in designing facilities for higher education are likely to be quite different in the future than they have been in the past.

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1. Darrel J. Monson, Assistant Academic Vice-President for Learning Resources, Brigham Young University, "What is Happening to the Lecture Hall?" Address given to a Regional Meeting of Physical Plant Administrators of Universities and Colleges, Provo, Utah, 1973.

Classrooms, lecture halls, and auditoriums will most likely be constructed in forms and shapes different from those we have been accustomed to seeing. Carpeting will be an acceptable floor covering throughout, and it will do much to improve acoustics, which will be given much greater consideration in the future. Auditoriums are likely to be designed and constructed in such a way that pushing a button will produce different sizes and shapes almost instantly. All this and much more is on the way, but it is possible that the biggest and most far-reaching changes may occur in the field of learning-resources facilities.

In the beginning, it was one square or rectangular room, one teacher, one blackboard, and one captive class of students anxiously waiting for the class period to end. Then, around the turn of the century, progressive schools started using, for entertainment and instruction, such devices as the "Magic Lantern," the talking machine or Graphophone, Stereopticons, and crude motion-picture outfits. These various devices could be purchased for as little as 60 cents and as much as $100. Some operated on coal oil or kerosene, and some came with electric arc lamps and rheostats for reducing current. Over the years, the "Magic Lantern" developed into the projectors of varying types and configurations that are in use by the thousands in present-day schools.

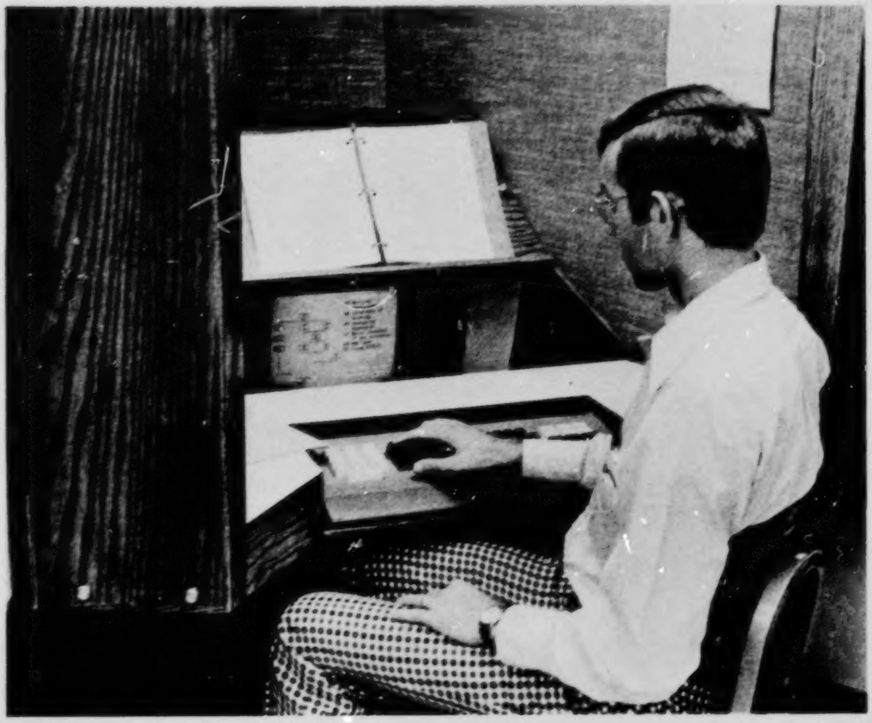
Also, in the early 1900s, radio was developing, and interest in it was growing rapidly. The first sets were crude affairs, but students with an interest in scientific, mechanical, or electrical fields were tremendously interested in learning how radio worked. Between the turn of the century and World War I, some future engineers and radio technicians got their earliest training by building simple receiver sets. Sometimes these sets consisted of little more than an oatmeal box, some cooper wire, a few stove bolts, a "Hot Shot" battery, a "cat's whisker," a piece of galena, and a headset. As radio developed, it was used to a limited degree in the schools. It did not require much space and needed only an aerial wire stretched between two points and connected to the set to make it work. As a consequence, radio had no influence on the design of school rooms or buildings.

Television started coming of age in this country in the period 1936-40 and really made its presence felt from 1940 to 1950. Thus, it has taken approximately fifty years to go from crude, coal-oil-burning "Magic Lanterns" to color television. But in the past fifteen years, so many new devices have become available, for both entertainment and learning, that a whole new concept in teaching, learning and educational facilities planning has evolved. We now hear media-wise faculty and staff members casually speaking of teaching machines, microprojectors, overhead projectors, rear-view screens, tape recorders, small videotape cassette players, videodiscs (which are read by laser beams), cable television with two-way television capabilities, and

"Time-Shared Interactive Computer Controlled Information Television," fortunately called TICCIT for short. (Any terminal tied to a special cable television system which is in turn tied to a TICCIT sending source could get individual educational programs.)

*With the demand for education outstripping education's income, more effective and efficient learning is vital. Instructional technology has shown its ability to speed up the rate of learning. It can help the teacher make better use of his time. It can reduce the teacher's heavy burden of administrative tasks and take over some of the teacher's routine job of information transmission. Thus, the teacher would be able to spend more time on* teaching—*inspiring students to learn and encouraging them to apply newly acquired information in useful and interesting ways. . . .*

*Group-paced and group-prescribed instruction seems to be a virtual neces-*



**Learning English and mathematics by computer. Here is an individualized carrel showing the keyboard-controlled television monitor that is linked to a computer wherein is stored the courseware and teaching program for freshman composition and mathematics. The computer keeps a record of the achievement and standing of each student.**

*sity when resources are restricted to teacher and textbook. But technology properly applied opens up many different ways of learning. Individual differences can be taken seriously. The traditional rigid control and standardization of what students learn, how they learn, when and at what pace, is no longer necessary. One teacher per thirty students no longer has to be the dominant pattern for the public schools. The live lecture as the most common medium of instruction in higher education can now be questioned. Different combinations of teachers, students, materials, space, time, and dollars can respond more to actual learning needs and less to administrative convenience.*

*Freedom and self-direction have always been accepted as goals of American education. The use of technology in education can increase the alternatives and permit the student to find his own direction more easily. The pluralism of educational objectives in a democratic society can only be reached by using a plurality of means.*[2]

*Higher education (and education generally) now faces the first great technological revolution in five centuries, and the potential impact of the new electronics.*

*By the year 2000, it now appears that a significant portion of instruction in higher education on campus may be carried on through informational technology, perhaps in a range of 10 to 20 percent. It certainly will penetrate much further than this, into off-campus instruction at levels beyond the secondary school; in fact, it may become dominant there, at a level of 80 percent or more.*[3]

Dr. Harold R. Hickman, formerly assistant division director, Media Services, Brigham Young University, was asked to comment on the future of instructional technology and its possible influence on planning school buildings. The following are some of his timely and enlightened observations:

*More and more we are looking to the term* Instructional Technology *to cover all the materials and equipment with which we work. Included in this group is the old audiovisual equipment that most instructional people know and use; in addition to that, though, we have added some new sophistication, especially in the electronic area, to broaden the concept of instructional materials far beyond the old concept.*

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[2] "To Improve Learning," A Report to the President and the Congress of the United States, by the Commission on Instructional Technology, Carl D. Perkins, Chairman, March 1970, United States Government Printing Office.

[3] "The Fourth Revolution: Instructional Technology and Higher Education," Report and Recommendations by the Carnegie Commission on Higher Education, June 1972.

*In the last five years there has been a tremendous increase in the amount of technology in the educational field. Some of this has been quite subtle; other advances have had a marked effect on education.*

*Perhaps the greatest advance has been in the field of electronics. And this has come about principally because of its application in the space programs. The increase in the use of sophisticated calculators in engineering, math, accounting, and other sciences has been remarkable. Most everyone recognizes that the calculators used in engineering today are nothing less than miniature computers capable of very sophisticated calculation and storage. But few people stop to consider that these electronic wonders are really audiovisual tools. They are part of the new instructional technology.*

*The same technology has been used in other instructional technology to bring about marked changes (although not on the broad scale that the calculators have seen). For example, it has not been very many years since the audio cassette unit was introduced on the market by the Norelco Corporation, but already many students are using their personal audio cassette units for instructional purposes to record lectures, to record notes, even to produce papers.*

*We are rapidly reaching the point when the same technology will give us video units of a fairly inexpensive kind. This will take the form of the video disc. Currently we have a number of units that students can operate, but the price of these units is beyond their capabilities. However, because the video disc and its software are relatively inexpensive, the potential for the video disc in education is exciting.*

*In reality, the "learning wall" concept—a total media instructional system in the form of electronic units—is not that farfetched. Many colleges now have individual study carrels that are very sophisticated from the standpoint of their electronic capabilities. This trend will continue. Media packaging is becoming more and more a sophisticated procedure. Many of these media packages are multimedia in form, utilizing some videotape, some audio tape, and/or some film segments. The units are also becoming interactive in that during the presentation the student is asked to respond to questions presented to him. Because these packages are interactive, they must be student controlled, so that the student can turn the package on or off on cue. Such interactive packages are now putting pressure on centralized instructional elements (such as the centralized university computer system) to diversify.*

*Already these media packages are self-contained instructional units, and as they become more flexible in allowing students to learn subjects of their own choosing at their own pace, and to determine their own progress through competency-based testing, these self-contained instructional packages will become an increasingly basic requirement of education.*

*During the 1960s the trend was toward wiring all instructional buildings* *to centralized informational sources, such as closed-circuit cable systems, closed-circuit audio systems and centralized computers. It is my contention that during the late 70s and early 80s this concept will be reversed and that the wired-campus system will begin to disappear. The reason can be seen in a number of areas. As already stated, interactive learning systems require that the student have control over the starting, stopping, pausing, and basic operation of a multimedia or mediated-learning package. This is virtually impossible (with the exception of computers) when using campus-wired systems such as CCTV. Even centralized learning resource centers in libraries and other locations may find themselves diversifying their mediation systems.*

*In the future, media systems will be portable and cheap enough for student purchase. We have already noted this in the field of calculators and audio cassette players. The same thing will be true in video disc players: they will tend toward decentralization, toward diversification and individual use. The trend is already apparent on the Brigham Young University campus,*

The computer, television screen, and typewriter keyboard tied together in a modern teaching program of English and mathematics. This is the TICCIT system, which places the student in control of his progress in achieving knowledge of these subjects.

*where learning resource centers are springing up in almost all campus classroom buildings and are receiving favorable responses.*

*The "learning wall" concept, or centralized carrels with student-controlled media, will become more common in the future. These must have special kinds of facilities. Obviously these units must have an adequate power supply. And the carrel must also be hooked up to computers, CCTV, CATV, and dial-access systems. They must, of course, have adequate light control, so that students can see projected images. Total darkness is not necessary, but subdued light is often important. The old days of big windows in the classroom have disappeared largely because of air conditioning, but the side effects have been very favorable to mediation systems. Light-level control is essential, and reflection from windows on television sets and other projection screens is obvious.*

*Classrooms are moving toward more flexibility for small-group mediated learning; and this trend will continue, not only toward small-group learning, but also toward individual student learning from mediated systems.*

*Because of the ability of mediation to provide various experiences along a common instructional line, classrooms and learning centers must be built to provide the student total experience from a number of information sources. This includes mediated instruction from television, film, audio, and computers, and it also includes realia experiences in the classroom and 'hands on' experiences with learning situations.*

*Nothing that I have said here rules out the basic instructional media unit, which is the book, as a continuing source of information; in this total learning complex, the student will rely very heavily on books.*

*The various media devices can be subdivided into three classes: filmatic and projection; video, including video distribution; and audio.*

Filmatic and Projection. *The media devices in this area include those using projections on large screens from film processes or from transparencies of one kind or another. Included here are the traditional 16mm projector, the 8mm reel projector and closed-loop systems (including single-concept 8mm loop projectors), filmstrips (including synchronized or unsynchronized sound), slide/sound presentations utilizing standard 2" x 2" or 35mm slides with corresponding audio cassettes, and overhead projector systems and opaque projection systems. The overhead projector is becoming more and more a standard in education, although the opaque projector, because of its size and bulk, has not achieved much popularity.*

Video Systems. *Here we are talking about electronic visual-production systems, including the open-reel videotape recorder (many schools are using the 1/2 inch EIAJ standard machines of this type and are finding them quite* *satisfactory); the cassette recorder (basically, this system is the 3/4-inch U-format recorder instituted by the Sony Corporation of Japan and being copied by a number of manufacturers), which is becoming a staple in the use of video in education across the country; minicassettes, including the Beta-Max system from Sony, which is a smaller version of the cassette recorder system utilizing a much narrower tape width and a much slower transport speed for the tape; and, of course, video disc.*

*From the standpoint of video distribution, there are three types of distribution systems for video. There is the traditional broadcast system such as we see on regular commercial broadcasting and public broadcasting operations; there is the videotape (which we have already mentioned), a very viable tool for sending programming from one point to another; and, of course, there are the cable systems, such as closed-circuit television systems (CCTV) and the community antenna television systems (CATV).*

Audio Systems. *Because of the cassette recorder, audio seems to be getting more attention these days. In addition, there is the open-reel recorder, still very popular both as a recording mechanism and as an instructional mechanism for playback of software information. And there is the traditional long-playing stereophonic disc.*

### The Effect of Video Disc on Instruction.

*Video disc is perhaps the most exciting innovation in mediated learning since the chalkboard. Certainly it will dramatically affect classrooms and learning. It is inexpensive: video disc players should cost no more than $500, and the software discs for playing on these units will cost no more than a standard audio LP album. These units are very flexible in that they can play, they can stop and still frame, they have reverse action and a fast forward, and they can handle many other kinds of procedures. In addition to that, future models will have the ability to digitally index each frame on the disc so that the student using a special calculator keyboard will be able to locate a specific frame on a video disc for careful study.*

*The units will be extremely simple to operate, with only a few buttons to worry about. The player operates much like an audio disc player, except that the information is extracted by a small laser beam. Because the laser scans the disc below the surface, there is no mechanical interaction with the stylus; consequently, the disc should last forever, and, barring mutilation, the fidelity will not deteriorate. In other words, the discs themselves are virtually impossible to wear out.*

*The most dramatic educational technology elements in the past have been those units that have also had a great consumer usability. For example, the electronic calculator has won its place in the lives of everyone, and the audio* *cassette player is common in every household. There is little question that the video disc system will be as common in households of the future as are audio cassette players today.*[4]

*One thing appears fairly certain; the potential market for video discs can run into billions of dollars annually. The American public now spends more than two billion dollars every year on phonograph records, with buyers in other countries adding a substantial amount to the U.S. total. Combine sight with sound, and it isn't unreasonable to see almost limitless possibilities for entertainment, instruction and profits, all locked inside tomorrow's miraculous video disc.*[5]

"With a storage density of more than 7,750,000 bits per square inch, or 50,000 frames or pages of a book, on one side of a video disc, we have better economy for our money than is obtainable any other way. This means that a library of one million books with 400 pages each (400 million pages), which requires at least 22,500 cubic feet or 15 x 15 x 100 feet of floor space can be stored on video discs in 9 cubic feet or 3 x 3 x 1 foot of floor space."[6]

*We should not ignore the promised, but continually delayed introduction of video disc. This is certainly one of the most potentially universal media systems to come along, and it will probably have an impact in the area of media production. (But the initial impact will be far less than the proponents predict.) Because it consists of only a playback unit and traditional TV monitors, it will probably require very few physical modifications in what is now available.*

*Unquestionably, developments in instructional technology will cause some modification in the way physical facilities are now designed. However, I would encourage a cautious approach in certain predictions as sometimes even the most sensible dreams encounter trouble in the translation into reality. I have dreamed my dreams, as has nearly everyone in the media field, but we have not seen as great an impact on the total system of education as originally might have been hoped. Many innovations that have come on with all the trappings of potentially successful undertakings have fizzled in the*

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[4] Harold R. Hickman, Former Assistant Division Director, Media Services, Brigham Young University, Memorandum to Author, 22 March 1976.

[5] Robin Lanier, Associate Editor of *BM/E*, Technical Journal of the Broadcasting Industry, "A Home T.V. Revolution," *The New York Times Magazine*, 25 May 1975, p. 9.

[6] H. A. E. (Eddy) Zwaneveld, Division of Media Development and Production, Brigham Young University, Provo, Utah, 1976.

*face of economic and strategic reality. The most current trend in all levels of education seems to indicate a gradual return to the more traditional types of instruction. Throughout the country, wall-less modular school buildings offering open-structured scheduling and curriculum are building walls and adding more curriculum structure. Vast quantities of instructional hardware and software are gathering dust because the potential users have become disenchanted with spiraling costs, lack of maintenance, public displeasure, and a myriad of other pressures. Also, the once-touted built-in media systems are standing idle for lack of expensive and demanding planning and integration.*

*We have, however, witnessed many worthwhile and, I believe, lasting related changes in the design of physical facilities. These include carpeted and acoustical classrooms with light- and temperature-control capabilities and an adequate power supply. Flexible multipurpose furniture and movable walls are likewise here to stay. The concept of the media center has been useful, even though its actual use has evolved into something quite different than was originally intended. Maintenance problems have unquestionably been reduced, and the general atmosphere in the newer building designs is certainly more conducive to learning. I hope to see this trend continue.*

*One of the more lasting concepts in individualized study and media distribution is the learning resource center, which offers an environment for utilizing the gamut of nonprint media. Commercial enterprise has really jumped into this one, and good materials are available across the board. My feeling is that because of the availability of relatively inexpensive good materials and because of the high cost of using and maintaining a centralized unit, we will see a continuing increase in this type of facility. These centers, of course, have vastly changed the look of the traditional library and will continue to. But it will be many years before they supersede the accessible, economical book—if, indeed, they ever do so.*

*We will also see some improvements in other media formats, such as audio and video recordings. These, however, will be married to existing monitors and support facilities for some time to come.*

*I believe that because the large classroom TV is expensive and cumbersome, it has peaked out and will decline in popularity. But the simpler, less expensive systems and strategies probably will never totally supplant TV.*

*Some media currently in use at Brigham Young University are—*

1. *all types of "traditional" A-V equipment (16mm, audio and video players, overhead projectors, slide/filmstrip, etc.),*
2. *music listening systems,*
3. *dial access (with some remote terminals),*
4. *television (classroom, cable, portable systems, etc.),*

5. *learning resource centers (with a full complement of media utility),*
6. *a student-response system (with questionable utility),*
7. *a microwave audio and video link with some remote locations, and*
8. *Tele-tip (a precounseling system).*

The Future. *There will be greater emphasis on competency-based instruction (i.e., on deciding exactly what the student is to learn and then carefully testing to determine if learning has taken place) and on the use of media in testing.*[7]

*Learning resources centers will increasingly become the focal point of instruction: students will have greater contact with a broad range of media for individual study.*

*Video discs will make motion pictures and television programming readily available to the teacher in the classroom and to the student in the Learning Resource Center.*

*Computers will be involved more and more in the instructional process as some special-purpose systems become cheaper and as programs divide. The computers will be used for direct on-line instruction, for correcting and scoring student tests, for diagnosing student achievement and prescribing additional instructional activities, and more for comprehensive record keeping.*[8]

**Summary**

Educational-media hardware and techniques will continue to evolve. As a result, many older school facilities will need to be remodeled to accommodate new educational-media devices, and the acoustical, electrical, and mechanical systems needed to support them. It is also apparent that architects, engineers, and programmers of educational facilities should consult frequently with, and rely heavily upon, the learning resource personnel at their respective schools, not only for the mechanical and electrical systems needed, but also for recommendations on shapes, forms, and sizes of rooms.

School building designs and details commonly used in the past may not be adequate in the future. Teaching methods are being evaluated, and changes are being made. Architects and engineers will adjust to these changes, because they make every effort to produce what is needed and wanted by their clients. Teachers, however, may be slow to accept some of the newer media; but many will adapt, and in time there will be young teachers who received part of their education from such media and who like the techniques. But they in turn will probably be slow to adapt to still newer methods of teaching that will develop during their teaching careers.

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[7] Ted C. Hindmarsh, Director of Learning Resources, Brigham Young University, Memorandum to Author, 22 March 1976.

[8] Irwin Goodwin, Former Director of Division of Instructional Research Development and Evaluation, Brigham Young University, Memorandum to Author, 22 March 1976.

Buildings or portions of buildings planned and constructed to satisfy current methods of teaching could be outmoded in a few years by newer practices and methods. For that reason, the planning of academic buildings should be kept as flexible as possible, so as to make them more easily adaptable to future requirements.

# Appendixes

# Appendix A: Questionnaire on Planning and Construction

This is a list of universities and colleges that contributed information on planning and construction. Because these schools were selected for their diverse sizes, types, and locations, it is believed that their replies will typify planning and construction policies and procedures at most universities and colleges.

It is interesting to note the differences in administrative organizations and approaches to planning and construction at the several schools. All the schools have had the same concern—how to plan and build efficiently and economically. Each has established an organization and a set of policies to accomplish that goal. It is certain that many schools would approach their problems differently if they were not required to conform to policies and procedures established by the legislative and governing bodies of their respective states. However, some have undoubtedly been more successful than others. A study of the various ways that the following schools have approached their planning and construction problems should help the school administrator determine anything he is not doing that he should be or, perhaps, a better way to organize and administer his program.

1. Alaska, University of
2. Arizona State University
3. Arizona, University of
4. Auburn University

5. California, Riverside, University of
6. Chicago, University of
7. Colorado State University
8. Dixie College
9. Duke University
10. Earlham College
11. Fisk University
12. Goshen College
13. Kansas State University
14. Maine, University of
15. Michigan State University
16. Mississippi, University of
17. Missouri, University of
18. Montana State University
19. Murray State University
20. Nebraska Medical Center, University of
21. New Mexico State University
22. Oregon, University of
23. Prince George's Community College
24. Providence College
25. Purdue University
26. Simon Fraser University
27. Southern Colorado State College
28. South Dakota State University
29. South Dakota, Vermillion, University of
30. South Florida, University of
31. Southern Illinois University at Carbondale
32. State University of New York at Albany
33. Swarthmore College
34. Texas A. and M. University System
35. Troy State University
36. Tufts University
37. Tuskegee Institute
38. Utah, University of
39. Washburn University of Topeka
40. Washington State University
41. Williams College
42. York University

## Information on Planning As Reported by Forty-Two Universities and Colleges

| Questions | Answers |
|---|---|
| How are architects and engineers selected for new major facilities?<br>NOTE. The replies to this question were so detailed and the methods used so dissimilar that only a few fairly typical methods could be listed. | Univ. council and State Building Board |
| | Univ. president and State Building Committee |
| | Univ. committee recommends; Board of Regents approves |
| | Demonstrated ability |
| | Selected by state |
| | Univ. administration recommends to commissioner, higher education |
| | Selected from approved state board list |
| | Selected from univ. alumni |
| | Facilities Planning and Selection Committee |
| | Univ. president makes selection |
| | Univ. Architect Selection Committee recommends to president and Board of Trustees |
| | Facilities Planning recommends to administration and Building Committee |
| | Director, Physical Plant and Facilities Planning recommends to financial vice-president and Board of Trustees |
| | Faculty and Staff Committee |
| | Univ. architect recommends three firms to executive vice-president on a 1, 2, 3 basis with no. 1 preferred. Recommendation goes to president and Board of Trustees |
| How are architectural fees determined?<br>NOTE. Just a sampling of replies; but many use the AIA scale, negotiation, or fees established by governing agencies, and generally with variations. | State Building Board scale |
| | Set percent of construction cost |
| | AIA scale and negotiated |
| | Negotiated on estimated cost of project |
| | AIA scale |
| | Set by state director, Maintenance and Construction, under direction of State Department of Administration |
| | State engineer negotiates |
| | Flat hourly fee |
| | Set by State Capital Development Board |
| | Bids requested |
| | State scale and negotiated |
| | Set by state engineer and commissioner, higher education |
| | State Architect Council Scale |
| | Schedule of building types |
| | Six percent, which includes supervision |
| | Six percent for new construction; 8 percent for remodeling |
| | Vice-president negotiates with architect |
| | Sliding scale (5.5 percent to 11.7 percent) |
| Who, by title, has the | State Building Board |

| | |
|---|---|
| responsibility for finally approving working drawings and specifications, and who authorizes asking for bids or tenders?<br>Note. A sampling of replies. No strong general trend. | Campus architect<br>State Board of Higher Education<br>Univ. president<br>Business vice-president<br>Director, Facilities Planning, and Director, Construction<br>Director, Physical Plant and Construction<br>State Univ. Construction Fund<br>Univ. Administrative Board<br>Univ. architect<br>Univ. chancellor and State Board<br>State engineer<br>Academic vice-president and director, Planning and Construction<br>Chairman, Planning Committee<br>Business manager<br>State Department of General Services<br>Financial vice-president<br>Director, Physical Facilities<br>University architect/engineer<br>State Division of Public Works<br>Director, Physical Resources<br>State director, Maintenance and Construction<br>President, Univ. System<br>Director, Physical Plant<br>General Manager, State University Construction Fund<br>Board of Trustees<br>Division of Public Works<br>Board of Regents |
| As head of planning, who, by title, do you report to?<br>NOTE. A great variation of replies, but a large majority report to a vice-president or to a person in charge of business or finance. | Administrative vice-president<br>Business manager<br>Business vice-president<br>Univ. president<br>Assistant director, Physical Resources<br>Financial vice-president<br>Director, Physical Plant<br>Vice-president for Management and Planning<br>Academic vice-president<br>Univ. comptroller<br>Director, Finance<br>Vice-president for Development of Services<br>Univ. treasurer<br>Director, Physical Plant and Construction<br>Vice-chancellor for Business and Finance<br>Executive director, Business and Fiscal Affairs<br>Executive vice-president<br>President, Univ. System<br>Vice-president, Administration and Finance<br>Vice-president for Business Management<br>Vice-president and treasurer<br>Director, Facilities Planning and Construction |

| Questions | Answers | Schools |
|---|---|---|
| Which best describes who prepares plans and specifications for new major physical facilities at your school? | Private architects/engineers | 35 |
| | School architect/engineer (on salary) | 1 |
| | Comb. private and school architect/engineer | 4 |
| | Comb. private and state architect/engineer | 1 |
| | Comb. private, state, and school architect/engineer | 1 |
| Do you have a campus master plan? | Yes | 38 |
| | No | 4 |
| If you have a campus master plan, is it kept current? | Yes | 26 |
| | No | 9 |
| | Somewhat | 2 |
| | No reply | 1 |
| If you have a campus master plan, who prepared it? | University Planning Office | 2 |
| | Consultants | 11 |
| | University Planning and consultants | 1 |
| | University Planning and Physical Plant | 1 |
| | Building Committee and architect | 1 |
| | Administration | 1 |
| | Chancellor; Executive Director, Business; and director, Physical Plant | 1 |
| | Center for Environmental Structure | 1 |
| | Consulting architect | 7 |
| | Physical Plant | 2 |
| | Facilities Planning | 2 |
| | Department Planning and Construction | 1 |
| | Campus Park and Planning | 1 |
| | Physical Planning | 1 |
| | Campus Planning | 1 |
| | Outside landscape firm | 2 |
| | Planning and development | 1 |
| | Office of University Planning and Budgets | 1 |
| Do you have a campus master model? | Yes | 24 |
| | No | 17 |
| | Partial | 1 |
| Is it kept current? | Yes | 12 |
| | No | 12 |
| | No reply | 1 |
| Do you have a Campus Planning Committee? | Yes | 25 |
| | No | 17 |
| Who does the Campus Planning Committee | Provost | 1 |
| | President | 15 |

| | | |
|---|---|---|
| report to? | Chancellor | 3 |
| | Vice-president and treasurer | 1 |
| | Executive vice-president and vice-president, Business and Finance | 1 |
| | Vice-president, Finance and Planning | 1 |
| | Univ. Senate and vice-president, Business and Finance | 1 |
| | Board of Trustees | 1 |
| | President, through business manager | 1 |
| Are the recommendations of the Campus Planning Committee given serious and prompt consideration by the top administrators? | Yes | 24 |
| | No | 0 |
| | No reply | 1 |
| Do you have your architects submit scale models on major building projects? | All the time | 7 |
| | No | 4 |
| | Occasionally | 31 |
| On major jobs, do you have architects submit rendered perspectives suitable for framing? | Yes | 31 |
| | No | 4 |
| | Occasionally | 7 |
| Do you prepare a written program of requirements for major projects | Yes | 36 |
| | No | 5 |
| | No reply | 1 |
| Do you have a carefully prepared document of "Instructions to Architects and Engineers" that is applicable to all jobs and used to supplement program requirements on each major project? | Yes | 24 |
| | No | 18 |
| At the beginning of each major project, do you supply your architects with the following? | | |
| 1. A written program of requirements | Yes | 36 |
| | No | 6 |
| 2. A copy of "Instructions to Architects/Engineers" | Yes | 24 |
| | No | 18 |
| 3. A topographic map | Yes | 40 |
| | No | 2 |
| 4. A soils report | Yes | 33 |
| | No | 9 |

| | | |
|---|---|---|
| 5. A trip report made after you have visited a few schools who have recently completed projects similar to the one you have authorized | Yes | 10 |
| | No | 23 |
| | Sometimes | 6 |
| | No reply | 3 |
| Do you have a central planning office at your school, with a professional staff, which has major responsibility for the following? | | |
| 1. Recommending or selecting architect/ engineers | Yes | 29 |
| | No | 13 |
| 2. Working closely with ad hoc committees in preparing program requirements for new major physical facilities | Yes | 33 |
| | No | 9 |
| 3. Reviewing and critiquing plans at all stages of development | Yes | 32 |
| | No | 10 |
| 4. Writing architects/engineers contracts | Yes | 24 |
| | No | 18 |
| 5. Preparing plans for alterations and repairs | Yes | 29 |
| | No | 13 |
| 6. Dealing with architects/ engineers on major jobs | Yes | 33 |
| | No | 9 |
| What form of architectural contracts do you use? | R.A.I.C. | 1 |
| | AIA and college | 1 |
| | AIA | 14 |
| | Univ.-developed | 22 |
| | Developed by state engineer | 1 |
| | Developed by State Building Board | 1 |
| | State form | 1 |
| | State Department of Administration | 1 |
| As head of planning, what is your professional training? | Mechanical and electrical engineer | 1 |
| | Architect | 9 |
| | Civil engineer | 8 |
| | Mechanical engineer | 5 |
| | Electrical engineer | 2 |
| | Landscape architect | 2 |

| | |
|---|---|
| Institutional planning and administration | 1 |
| Urban planner | 2 |
| Administrative | 1 |
| Commerce | 1 |
| Faculty | 1 |
| Ph.D. education, educational planner | 1 |
| Public service engineer | 1 |
| Physical plant administration | 1 |
| Architecture and business | 1 |
| Architect and landscape architect | 1 |
| Experience | 3 |
| No reply | 1 |

## Information on Construction As Reported by Forty Universities and Colleges

| Questions | Answers | Schools |
|---|---|---|
| How are requests for bids or tenders made? | Advertising or negotiated | 3 |
| | Advertising | 29 |
| | Selected prequalified bidders | 3 |
| | Negotiated | 2 |
| | Selected or negotiated | 3 |
| Who opens bids? | Administrative director, State Univ. Construction Fund | 1 |
| | State Board | 1 |
| | Purchasing agent, Director, Physical Plant | 1 |
| | Assistant financial vice-president | 1 |
| | Financial vice-president | 2 |
| | Director, Physical Plant | 4 |
| | Business vice-president and director, Facilities Planning | 1 |
| | Purchasing agent | 6 |
| | Committee | 1 |
| | Manager, Plant and Purchasing, architect | 1 |
| | Physical Planning and Univ. architect | 1 |
| | Vice-president | 2 |
| | Planning Committee | 1 |
| | Assistant director, Facilities Planning | 1 |
| | Department General Services | 1 |
| | Governing Executive Council | 1 |
| | Univ. architect | 1 |
| | State Committee, univ. architect/engineer, administrative vice-president, director, Physical Plant | 2 |
| | State engineer | 3 |
| | Division of Public Works | 2 |
| | Business manager | 1 |
| | Vice-chancellor | 1 |
| | Director, Physical Plant, and business manager | 1 |

| | | |
|---|---|---|
| | State Division of Purchasing | 1 |
| | State Building Commission and Univ. Purchasing | 1 |
| Who makes the final decision to award or not to award a construction contract? | State Governing Board | 1 |
| | Administrative vice-president | 1 |
| | Business manager, director, Physical Plant | 1 |
| | Facilities Planning, Physical Plant, Business vice-president | 1 |
| | Planning Office and Construction Department | 1 |
| | President or chancellor | 2 |
| | Director, Physical Plant and architect/engineer | 1 |
| | Board of Governors, Univ. president | 1 |
| | State Public Works Department | 1 |
| | State Board | 1 |
| | Purchasing agent, director, Physical Plant | 1 |
| | Univ. Administrative Board | 1 |
| | State official, Univ. Administrative Board | 1 |
| | Director, Planning and Construction | 1 |
| | Business manager, provost, univ. president | 1 |
| | Facilities Planning Office | 1 |
| | State Building Commission | 1 |
| | President, vice-president for Development and Business Manager | 1 |
| | Vice-president, Business Affairs | 3 |
| | Director, Finance | 1 |
| | Board of Examiners | 1 |
| | State Board of Agriculture | 1 |
| | Vice-chancellor | 1 |
| | Vice-president or director, Physical Plant | 1 |
| | Director, Finance | 1 |
| | Treasurer, Building Committee | 1 |
| | State Department of General Services, Univ. administration | 1 |
| | Vice-president, Business and Finance | 1 |
| | College Board of Managers | 1 |
| | Board of Regents or Trustees | 8 |
| Where are your bids normally opened? | Univ. Purchasing, State Board | 1 |
| | Administration Building, vice-president for Business | 1 |
| | Public opening | 1 |
| | Univ. Board room | 3 |
| | Construction site | 1 |
| | Office of director, Facilities Planning | 2 |
| | Univ. architect's office | 1 |
| | State office | 4 |

| | | |
|---|---|---|
| | On campus | 9 |
| | Business office | 2 |
| | Physical Plant office | 4 |
| | Office of vice-president | 2 |
| | Student union building | 1 |
| | Univ. auditorium | 1 |
| | Public Works office | 1 |
| | State capitol | 3 |
| | Facilities Planning and Construction | 1 |
| | Architect's office | 2 |
| Any preferred day? | Monday | 1 |
| | Tuesday | 6 |
| | Wednesday | 3 |
| | Thursday | 5 |
| | Tuesday through Thursday | 16 |
| | No | 9 |
| Any preferred hour? | 10:00 a.m. | 3 |
| | 11:00 a.m. | 1 |
| | 12:00 noon | 1 |
| | 1:00 p.m. | 1 |
| | 2:00 p.m. | 17 |
| | 2:30 p.m. | 1 |
| | 3:00 p.m. | 5 |
| | 4:00 p.m. | 1 |
| | No | 10 |
| What office writes construction contracts? | State Building Board | 2 |
| | State Maintenance and Construction Office | 1 |
| | Business | 5 |
| | Facilities Planning | 4 |
| | General Counsel | 1 |
| | Univ. purchasing agent | 2 |
| | Physical Plant | 5 |
| | Univ. architect | 2 |
| | Architect and Physical Plant | 3 |
| | Legal counsel | 1 |
| | Physical Facilities | 1 |
| | State Department of General Services | 1 |
| | Bureau of Public Improvement or Physical Facilities | 1 |
| | Consulting architect/engineer | 1 |
| | State Department of Finance | 1 |
| | State Division of Public Works | 2 |
| | State Building Commission | 1 |
| | Outside architect | 3 |
| | Construction | 1 |
| | State engineer | 2 |
| Do you ever prequalify? | No, never | 19 |
| | All the time | 11 |
| | Occasionally | 7 |
| | No reply | 3 |

| | | |
|---|---|---|
| Do you do your own landscape construction? | Yes and no | 4 |
| | Yes | 23 |
| | No | 12 |
| | No reply | 1 |
| If you don't do your own landscape construction, how do you get it done? | Contract | 5 |
| | Include in construction bid | 3 |
| | Bid out separately | 4 |
| Who does the day-by-day detailed building inspection during construction? | State Board and architect/engineer | 2 |
| | Univ. Construction Office | 2 |
| | Architect/engineer representative and Physical Resources | 2 |
| | Physical Plant | 14 |
| | Architect/engineer or representative | 5 |
| | Architect/engineer and Planning Office | 3 |
| | State inspector | 1 |
| | Architect/engineer, representative, and Physical Planning | 1 |
| | Architect/engineer, Physical Plant, Planning Office | 7 |
| | Physical Planning and State Department of General Services | 1 |
| | University architect | 1 |
| | No reply | 1 |
| Who initiates change orders? | Architect/engineer | 17 |
| | Physical Plant | 5 |
| | Physical Plant and architect | 2 |
| | Contractor and architect | 2 |
| | Planning Office | 1 |
| | Manager Plant and Purchasing | 1 |
| | Architect, Planning Office, contractor | 1 |
| | Office of Construction Management | 1 |
| | Physical Plant, architect/engineer, state engineer | 2 |
| | Univ. | 2 |
| | Consultant | 1 |
| | Owner, architect, contractor | 3 |
| | No reply | 2 |
| Who approves change orders? | Director, Planning and Construction | 1 |
| | State Board and architect/engineer | 1 |
| | Architect/engineer | 3 |
| | Univ. and consulting architect | 2 |
| | Univ. Construction Office | 1 |
| | Director, Physical Resources | 1 |
| | Facilities Planning Office | 2 |
| | Physical Plant | 5 |
| | Architect/engineer, owner, and State Board | 1 |
| | Business manager | 1 |
| | Univ. Administration Board and State Building Commission | 1 |

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|---|---|---|
| | Manager, Plant & Purchasing | 1 |
| | State official | 2 |
| | Business manager and provost | 1 |
| | Univ. treasurer | 1 |
| | Physical Plant, architect/engineer, state official | 3 |
| | State Univ. Construction Fund | 1 |
| | Contractor and architect | 1 |
| | Physical Facilities, State Bureau of Public Improvements | 1 |
| | Project manager | 1 |
| | University architect | 3 |
| | Institution, Public Works, Budget Office | 1 |
| | President | 2 |
| | Vice-president and treasurer | 1 |
| | Vice-president for Business and Finance | 2 |
| When are payments made to contractors? | Once a month | 34 |
| | When estimates are verified | 2 |
| | On request | 2 |
| | As work progresses | 1 |
| | No reply | 1 |
| Do you withhold a certain amount each month to insure final completion of a project? | Yes | 35 |
| | No | 4 |
| | No reply | 1 |
| How much is withheld each month to insure completion? | 5 percent | 6 |
| | 10 percent | 13 |
| | 12 percent, five percent, 2½ percent | 1 |
| | 15 percent | 2 |
| | 10 percent to 50 percent completion | 6 |
| | 10 percent and 5 percent | 7 |
| | No reply | 5 |
| Is there one department on your campus responsible for *both* planning and construction? | Yes | 30 |
| | No | 7 |
| | No reply | 3 |
| If *yes*, what is the name of the department? | Physical Plant | 15 |
| | Plant Operations | 1 |
| | Facilities Planning | 2 |
| | Planning Department | 2 |
| | Planning Engineer | 1 |
| | Physical Planning & Architect's Office | 1 |
| | Physical Facilities | 2 |
| | Facilities Planning & Construction | 2 |
| | Department of Buildings and Grounds | 1 |
| | Architect/Engineer | 1 |
| | Administrative Services | 1 |
| | Physical Planning & Construction | 1 |

| | | |
|---|---|---|
| If *no*, what department is responsible for planning? | Facilities Planning | 3 |
| | University Architect/Engineer | 1 |
| | Department of Campus Planning | 2 |
| | Campus Planner and Architect | 1 |
| If *no*, what department is responsible for construction? | Physical Plant | 5 |
| | Business Office and Physical Plant | 1 |
| | Buildings and Grounds | 1 |
| If *yes*, who does the department head report to? | Vice-president, Business Affairs | 2 |
| | Administrative vice-president | 2 |
| | Business manager | 1 |
| | Business vice-president | 2 |
| | Executive director, Planning | 1 |
| | Associate director, Physical Resources | 1 |
| | Financial vice-president | 1 |
| | Academic vice-president | 2 |
| | Comptroller | 1 |
| | Univ. treasurer | 1 |
| | Univ. president | 2 |
| | Director, Physical Planning | 2 |
| | Executive vice-president | 1 |
| | Fiscal vice-president | 3 |
| | Vice-chancellor, Business and Finance | 3 |
| | Executive director, Business Affairs | 1 |
| | Vice-president and treasurer | 2 |
| | Vice-president, Business and Finance | 1 |
| | Vice-president, Administrative Services | 1 |
| If *no*, do both departments report to the same man? | Yes | 4 |
| | No | 3 |
| Have you developed a system to prevent bid peddling? | Yes | 11 |
| | No | 20 |
| | Yes and No | 2 |
| | No reply | 7 |
| If *yes*, please explain.<br>NOTE. The replies were too long to include in this summary, but this is a brief capsule of some replies. | Bid component and subsystems separately and assign to general contractor | |
| | Prime contractor must submit list of subcontractors; no changes allowed without written consent of univ. | |
| | State auditors check bidding | |
| | Major equipment bids opened separately before general contractor's bids | |
| | General contractor must submit list of subcontractors and list of materials by manufacturer's names before bid is awarded | |
| | Subcontractor files proposal to general contractor with Association of General Contractors Office | |

| | | |
|---|---|---|
| | before general contractor bid openings | |
| Do you reserve the right to approve or disapprove subcontractors used by general contractors in putting their bids together? | Yes | 26 |
| | No | 12 |
| | No reply | 2 |
| Do you require a bid bond? | Yes | 35 |
| | No | 4 |
| | Require certified checks, cashiers checks, or money orders | 1 |
| Do you hold a contractor to his bid when he has made an honest and substantial error in putting his bid together? | Yes | 3 |
| | No | 23 |
| | Yes, if obvious, but with penalty | 6 |
| | No reply | 7 |
| | Situation never has occurred | 1 |
| Do you require a 100 percent performance bond? | Yes | 35 |
| | No | 3 |
| | 50 percent only | 2 |
| Do you require the contractor to name his construction superintendent before the construction contract is signed? | Yes | 17 |
| | No | 19 |
| | Reserve right to approve | 1 |
| | Sometimes | 1 |
| | No reply | 2 |
| Do you ever insert a liquidated-damage clause in your construction contracts? | Yes | 29 |
| | No | 10 |
| | No reply | 1 |
| Do you ever offer a bonus for early completion? | Yes | 3 |
| | No | 35 |
| | Rarely | 1 |
| | No reply | 1 |
| Do you ever insert a liquidated-damage clause without offering a bonus? | Yes | 27 |
| | No | 2 |
| If *yes*, have you ever collected against a liquidated damage clause? | Yes | 14 |
| | No | 13 |
| Do you think a liquidated damage clause without a bonus clause is legal? | Yes | 23 |
| | No | 11 |
| | No reply | 6 |
| Have you ever devised a way to insure that a con- | Yes | 3 |
| | No | 31 |

| | | |
|---|---|---|
| tractor will finish a project in accordance with the completion date specified in his contract? | Not yet | 1 |
| | Hopefully | 4 |
| | No reply | 1 |
| Do you ever prequalify bidders on major construction projects? | No, never | 19 |
| | Yes, all the time | 10 |
| | Occasionally | 8 |
| | No reply | 3 |

# Appendix B: Brief Case Histories

Duke University
University of Maine
Williams College
University of Nebraska Medical Center
University of Oregon
Brigham Young University
York University

## Planning and Construction at Duke University*

Duke University was established in 1924 when James Buchanan Duke signed the $40,000,000 Duke Indenture, which provided funds to develop a Methodist-sponsored liberal-arts college (Trinity College) into Duke University. A large woodland tract one mile west of the old Trinity College campus was purchased; Horace Trumbauer, architect from Philadelphia, was commissioned to design the new campus; and Duke Construction Company was organized to do the construction work.

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*Submitted by James A. Ward, Director of Physical Planning and University Architect

The old campus became the coordinate Woman's College when the new campus was occupied in the early 1930s. Whereas the old Trinity College campus is composed of Georgian-style buildings, the new west campus is of Gothic architecture, dominated by the majestic Duke Chapel. The new campus consisted of thirty-five buildings comprised of approximately 2,133,000 square feet, and few buildings were added to this complex until after World War II.

A self-study undertaken by the University in the 1950s established the objective of keeping Duke University listed among the top universities of the nation, and this objective included the Duke Medical School. It was realized that meeting this objective would require a great deal of physical-plant expansion to accommodate the growing academic program. The Long-Range Planning Committee began a program study and published an outline of desired expansion to accommodate this expansion in educational and research programs. This program, known at Duke as *The Fifth Decade*, called for a $120,000,000 building program.

The firm of Caudill, Rowlett & Scott (CRS) of Houston, Texas, was commissioned to prepare a design study of the Duke campus to serve as a guide for future buildings on the Gothic campus. Their report, published in 1963, submitted the following recommendation for future buildings:

> *The essence of Gothic architecture was the honest expression of plan and structure, and this functional approach must be the determinant of the future architectural character. From this foundation the use of materials and their enrichment must recapture the consistent human scale and the great variety of form and composition, along with the unity of proportion, color, and texture which is the essence of the Gothic style and of the Duke campus. In brief, future buildings must result from a problem-solving approach which pays deference to certain characteristics inherent in the original Gothic buildings and in the Duke architectural tradition. These inherent characteristics may be classified as verticality, human scale, richness, variety, and unity.*

CRS was retained to prepare a Comprehensive Campus Plan for the Fifth Decade building program and to serve as design consultants for all new buildings. The Comprehensive Campus Plan was approved by the Trustees in 1965, and the Fifth Decade Program was launched. The University Architect's Office was established (separate and apart from the Physical Plant Department and reporting directly to the chief financial officer of the University, the Vice President for Business Finance) to oversee the design and construction of this massive building program.

During the 1960s and early 1970s, seventy-nine new buildings were designed by architects from various parts of the nation. At Duke the project architects are screened and interviewed by an Architectural Selection Committee appointed for each particular project. This Committee consists of the University Architect, at least one Trustee member of the Building and Grounds Committee, at least one student, and prospective users of the facility. This committee makes its recommendation for project architect to the Building and Grounds Committee of the Board of Trustees.

The Building and Grounds Committee is composed of not fewer than five Trustees, at least one faculty member, at least one student, and the Vice President for Business and Finance, ex officio. (The University Architect sits with this Committee and advises it in architectural and planning matters.)

Aerial view of Duke University campus, 1968. Several buildings have since been constructed. (The East Campus, one mile from the main campus, is not shown.) The campus is characterized by splendid buildings of Gothic architecture, numerous quadrangles, and its location on a heavily wooded tract.

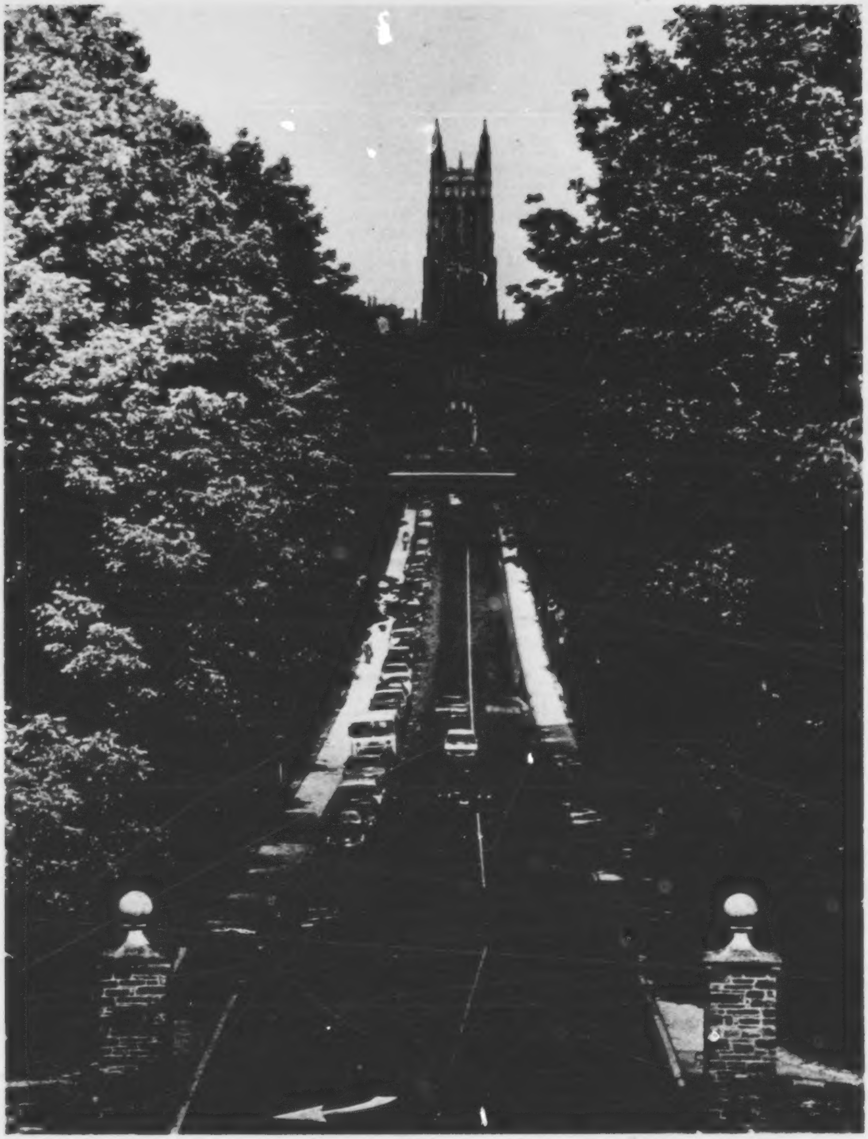
The powers and duties of this committee, as outlined in the bylaws of the University, are as follows:

*The Building and Grounds Committee shall consider proposals for and make recommendations with respect to:*
*a. Siting of all buildings and related appurtenances such as utilities, roads, and parking areas.*
*b. Commissioning of Project Architects and Engineers, and approval of proposed Contractors for construction projects.*
*c. Evaluation and promulgation of continuing Master Plan for long-range development of the total physical environment of the University, including inherent standards of aesthetics and quality.*
*d. Evaluation of design characteristics of individual projects for adherence to established standards.*
*e. Major renovation work.*

The University Architect (now also known as the Director of Physical Planning) reports directly to the Vice President for Business and Finance. He is charged with the following responsibilities, which are basically the same as when the office was created in 1962.

*Within the framework of Duke University's goals, the primary functions of the University Architect's Office (Department of Physical Planning) are as follows:*
*a. To advise the administration and faculty in architectural matters and long-range planning;*
*b. To coordinate the planning and acquisition of new facilities and other activities that affect the beauty, utility, and continuity of the campuses;*
*c. To provide architectural design services,*
*d. To administer and to control the cost of design and construction contracts and agreements involving the University,*
*e. To provide supervision of construction to ensure compliance with contract documents and determine final acceptability of facilities;*
*f. To serve in an advisory capacity to the Educational Facilities Committee, the Building and Grounds Committee, and to other members of the University community.*

*The above functions apply to all the physical facilities and surrounding landscape that are part of Duke University. Architectural services are to be available for all phases of planning, acquiring, furnishing, using, and altering facilities from the time when the need for improved facilities is first recognized to their disposition when obsolete.*



A photograph of the beautiful and majestic Duke Chapel. Of Gothic architecture, it occupies a dominant position on the all-Gothic West Campus.

The procedures for planning and constructing new facilities at Duke are still basically the same as those established at the beginning of the Fifth Decade Program. These procedures are as follows:

*When it is thought by a Department that their present facilities are inadequate, a "Users Committee" is appointed to outline the needs. After the needs have been formulated, discussions are held with the Educational Facilities Committee and administrative officials to determine the feasibility of renovation or addition to present facilities, or construction of new facilities. Once it is decided to proceed with the project, the aforementioned "Users Committee" is charged with the responsibility of preparing a functional program outlining the specific needs.*

*When the functional program has been approved by the Administration and funding has been established, the Vice President for Business and Finance presents this information to the Executive Committee of the Board of Trustees for approval of project definition and permission to proceed with the project, and the University Architect is then advised that this project is ready to be launched.*

*The University Architect then works with the "Architectural Selection Committee" and when recommendations are in hand for a Project Architect and building site, he takes the proposal to the Building and Grounds Committee of the Board of Trustees for approval of the location of the facility, the scope of the project, and the selection of a Project Architect.*

*The Project Architect, working with the University Architect and the "Users Committee," then writes the architectural program and prepares necessary documents which are taken to the Building and Grounds Committee for review and approval at various points in the planning process. While the Construction Documents are being prepared the University Architect keeps tab on the progress by conferences and visits to observe the work being done, making certain the project stays within the intended scope and meets University standards for design and quality. On completion of Construction Documents, copies of same are reviewed by the University Architect, the Physical Plant Department, and the "Users Committee," and when all corrections have been made, the project is advertised for bids.*

*After bids have been received, the proposal from the low bidder is submitted to the Executive Committee for approval to award contract.*

*The University Architect's Office is then charged with the responsibility for supervision throughout the construction, including final inspection and acceptance of the facility for the University.*

At Duke, the Department of Physical Planning (University Architect's Office) and the Physical Plant Department are separate, each reporting directly to the Vice President for Business and Finance. The Department of Physical Planning is charged with long-range planning and project execution for all projects $45,000 or larger. The Physical Plant Department is charged with the maintenance of all University buildings and project execution for all projects less than $45,000. These two departments work very closely with each other for consultation and shared responsibilities.

The Duke University campus in Durham, North Carolina, now comprises 212 buildings with a total of approximately 6,500,000 square feet. The value of these buildings (exclusive of equipment) is $200,000,000.

The current enrollment (Spring 1976) is 8,750 students—5,550 undergraduates and 3,200 graduate and professional students. This is Duke's largest enrollment ever, and the Administration has established approximately 9,000 as the future maximum enrollment projection.

Duke University is a private university, and its building program is financed by gifts, grants, and income from the Endowment.

The physical-plant expansion program known as the Fifth Decade Program is now completed. The University Planning Committee has stated that in the 1970s development at Duke will be concentrated on "people and programs" rather than on physical facilities. A fund-raising drive known as the Epoch Campaign was launched in 1973 to secure funds for these programs and some new or improved physical facilities. Two of the new facilities now being planned for early construction are a new University Center and Theatre facility (with 143,500 square feet and an estimated project cost of $7,300,000) and a new recreation facility (with 82,000 square feet and an estimated project cost of $2,720,000). In addition, a new Hospital complex is currently under construction (750,000 square feet and an estimated project cost of $90 million).

## Planning and Construction at the University of Maine*

The University of Maine is both an old and a new institution of higher education. The original University of Maine was established in 1865 in the town of Orono as the public "Land grant" University of the State of Maine. By 1968 the original University of Maine had grown in size to approximately 8,000 students. The one-campus University had grown to two campuses with the second being in the state's largest city, Portland. A third branch was being developed in the state's capital, Augusta. Over the years a somewhat parallel system of five state colleges had developed in the state. In 1968 the State Legislature created a "new" University of Maine with the resulting system known as the University of Maine. Through some administrative rearrangements, the resulting system had seven academic campuses spread across the length and breadth of the state.

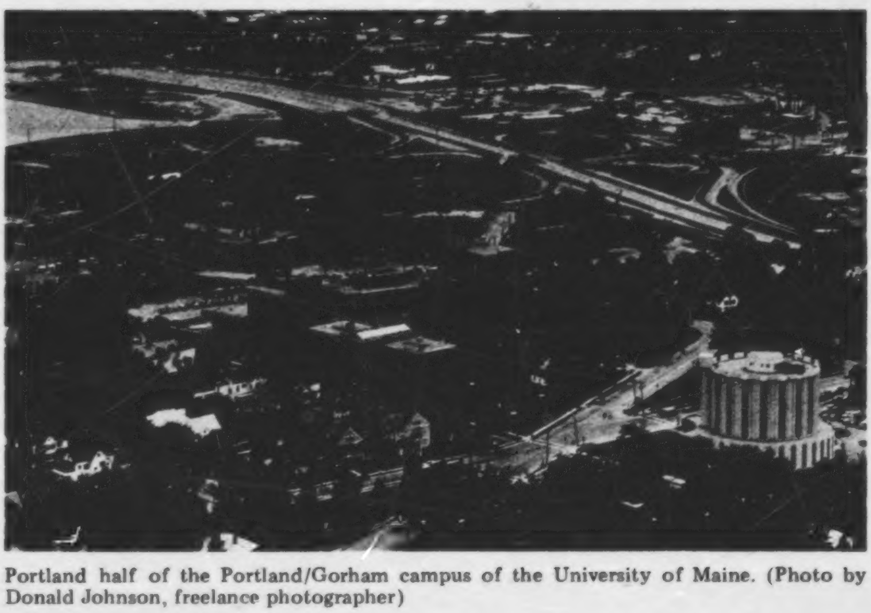
*Submitted by Richard A. Eustis, Director of Physical Facilities

Since 1968 the University of Maine has grown until in 1975 it had a student enrollment of approximately 18,500 in its day program and approximately 10,000 in the Continuing Education Program. The size of the campuses making up the University of Maine range from 11,000 students at Orono to 500 students at Fort Kent.

Although the University receives nearly 70 percent of its operating funds from the State Legislature, it is organized and operates as a separate nonprofit corporation. The University of Maine is operated under a Board of Trustees, by a Chancellor, who is the "chief academic and administrative officer."

Certain of the business functions of the University were centralized under the Chancellor to provide services to all of the campuses. One of the service functions which was centralized was the "planning and construction management of new facilities, including major alterations or renovations for all campuses of the University System." This function was one of those assigned to the Office of Physical Facilities when it was created shortly after the merger in 1968.

At the time of the merger, the old University of Maine (Orono Campus) had a well-staffed Physical Plant Department including a division responsible for the planning and construction of University facilities. The State College System had no such expertise, as this function had been carried on by a separate State Agency. The Chancellor, in staffing his organization, decided



Portland half of the Portland/Gorham campus of the University of Maine. (Photo by Donald Johnson, freelance photographer) it would be in the best interest of the System to staff his Office of Physical Facilities by transferring personnel from the Orono Campus to the Central Office as these staff members would be familiar with the problems of constructing University facilities.

One of the first tasks undertaken by staff members of the newly created Office of Physical Facilities was to review all material available on long-range planning for the various campuses. It became obvious that little attention had been paid in the past to the planning of physical-plant development. There was also a major deficiency in any long-range academic planning or long-range enrollment projections.

All these long-range plans and projections would take time to develop. As time was somewhat limited, it was determined that several of the planning processes should take place concurrently. The Office of Physical Facilities proceeded to develop a "Pilot Plan of Development" for each campus. This plan was not intended to be as detailed as a "Master Plan," but it was intended to identify potential building sites, establish traffic flow patterns, establish areas of major need, and establish areas for particular function development (i.e., housing, academics, physical education).

Simultaneous with the development of the "Pilot Plans" was a study of both the quantity and quality of various types of spaces on each campus as well as a study of the utilization of the various spaces. In addition, a study was made of the optimum enrollment that could be supported by the various types of facilities based on standards established by WICHE and a special note made of any severe shortages of classrooms, laboratories, office space, or library facilities.

All this information was then worked with the developing academic plans and enrollment projections. This process brought about a priority listing of new facilities needed by the University to perform its mission.

After the development of a priority listing, a study was made in sufficient detail to establish the total net assignable and gross area of each new facility as well as any special requirements of site or function which would influence the building costs. As a result of these studies, the Office of Physical Facilities established an estimated cost of each new facility needed by the University System. These were reviewed by the University's Board of Trustees with the highest priority projects being submitted to the State Legislature for funding.

Following approval of the funding by the State Legislature, detailed planning takes place. The first step is the appointment of a "Campus Building Committee" by a Campus President. This Committee might consist of an appropriate Campus Vice President, an Academic Dean, an Academic Department Chairman, two or more faculty members covering the academic disciplines for which the facility is being constructed, the Campus Physical

Plant Director, and, as an ex-officio member, a representative of the Office of Physical Facilities.

This Committee is charged with the preparation of a "Conceptual Plan" of the facility. This "Conceptual Plan" is defined as a description in narrative form of each room in the building, giving its function, capacity, special requirements or utility needs, relationship to other rooms in the building, and overall purpose. During the development of the "Conceptual Plan," the primary function of the Office of Physical Facilities is to guide the Building Committee and provide the technical expertise necessary for the development of the "Conceptual Plan." The representative of the Office of Physical Facilities also sees that any special requirements of each particular campus are included in the "Conceptual Plan" document.

Concurrent with the development of the "Conceptual Plan" is the selection of the project architect or engineer. The Office of Physical Facilities has been delegated the primary responsibility in the architect or engineer selection process. The Office of Physical Facilities, after careful review of the project and the design capabilities of the various design firms as well as a review of the workload of the design firms, prepares a recommendation of possible designers for the project. These recommendations are reviewed with the Campus President of the campus where the project is to be constructed. If the Campus President has, through previous experience, other suggestions for a design firm, these are also reviewed. After the several possible firms have been reviewed, the Office of Physical Facilities and the Campus President arrive at a unanimous recommendation to be made to the Board of Trustees based on design capabilities and ability to meet the required time schedule. Following approval of the recommendation by the University's Board of Trustees, an agreement is negotiated by the Office of Physical Facilities covering the design time schedule and the fees for the design work.

The Architect is not allowed to have a face-to-face meeting with the Building Committee until after the "Conceptual Plan" has been completed and the Architect has had a chance to review it. This requires that the Campus Building Committee make their own decisions and study of the problems rather than delegate this important phase to an outside designer. This also causes the members of the Building Committee to make a much more in-depth review of the function of each space early in the design phase.

Following the completion of the "Conceptual Plan" and the appointment of the designer, all communications between the University and the design firm are funneled through the Office of Physical Facilities. This assures that the questions from the Architect are channeled to the proper party and also that the design firm is not delayed because of inability to obtain answers to vital questions. Similarly, all instructions to the Architect about standardized

University of Maine, Orono campus, established in 1865 as the public Land Grant University of Maine. (Photo by Al Pelletier, photographer for Public Information Department, University of Maine at Orono)

technical requirements are transmitted to the design firm by the Office of Physical Facilities.

The Office of Physical Facilities is also responsible for the transmittal to the design firm of special University criteria such as requirements for the elimination of architectural barriers. These instructions will also include requirements for keying systems and standardization of brands or manufacturers. These instructions are prepared in cooperation with the individual Campus Physical Plant departments.

Once the "Conceptual Plan" is completed, translating the program into an actual building becomes the responsibility of the design firm. During the actual design phase, the Office of Physical Facilities maintains close contact with the design firm to assure that the project stays within the scope of the "Conceptual Plan" and the legislative intent.

During each phase of the design process, the developing plans and specifications are reviewed by the Office of Physical Facilities to assure that the design is in accordance with the instructions to the designers and within the project appropriation. Particular attention is given to the resolution of potential maintenance problems that appear in the design.

In accordance with University of Maine Board of Trustees policy, all projects estimated to cost in excess of $25,000 are publicly advertised and a contract awarded by a competitive bid process. On major projects, the University uses the "File Bid" Depository System established by the Associated General Contractors of Maine. Under this System, major subcontractors are required to "file" a copy of their bid to the various General Contractors with the AGC office. The General Contractor then must list the various subcontractors he proposes to use and the bid price of the subcontract work. After the General Contractor's proposals are opened, the file bids are opened and compared with the names and amounts listed in the General's proposals. Any variations are adjusted or any substitutions made based on the "filed" amount.

During the construction phase, the Office of Physical Facilities provides periodic inspections of the construction. It is believed the primary job of the "Resident Inspector" is to assure compliance with plans and specifications and provide a direct link with the designer's office for interpretation of the project documents. The designer is in the best position to interpret or explain his documents; therefore, the "Resident Inspector" should be an employee of the design firm. The Office of Physical Facilities must approve the selection of the Inspector, however, before he begins his work on the project.

During the course of the project, monthly meetings are attended by the General Contractor, Architect, Resident Inspector, and representatives of the Office of Physical Facilities. These meetings provide an opportunity to discuss job progress, change orders, payment requisitions, possible construction delays, and any other problems facing the project. These meetings provide an opportunity for the discussion and resolution of job-related problems before they can disrupt the actual construction progress.

At the completion of the project, a final inspection is made jointly by the Architect, his consulting engineers, and representatives of the Office of Physical Facilities. The results of this inspection provide the basis for the final "Punch List." This inspection is made prior to the occupancy of the facility by the University.

Prior to occupancy, an educational program is presented to the Campus Physical Plan Maintenance and Operating group. This session is given jointly by the General Contractor and appropriate mechanical subcontractors, the Architect and his consulting engineers, and personnel from the Office of Physical Facilities. During this period, detailed explanations as well as "hands-on" trials are given each mechanical system to demonstrate how each works. Explanations are also given on proper and timely maintenance of each part of each system so that the people responsible for the actual operations can gather appropriate information. In addition to the training session, the Architect, in cooperation with the Contractor, provides the University with two copies of all appropriate shop drawings, equipment parts lists, equipment maintenance instructions, and a listing of local representatives for the manufacturers of the various items of equipment.

During the first year of occupancy of any new facility, representatives of the Office of Physical Facilities "trouble shoot" any major physical problem that occurs in the new facility. This permits the Office to learn of maintenance "headaches" from the problems that occur. It also assures that problems that should be corrected by the contractor under the guarantees are referred back to the contractor and architect.

At the end of the first year of occupancy, representatives of the design firm and the Office of Physical Facilities make another inspection of the project. Items that should be corrected under the original contract are referred to the project contractor for action. This inspection also permits the project designer as well as Physical Facilities personnel an opportunity to see how and the various materials and systems are standing up under normal building usage.

### Planning and Construction at Williams College*

Williams College, Williamstown, Massachusetts, a small liberal-arts institution of considerable renown, was founded in 1793. At that time a single red brick structure, called West College, was erected and thus became the first educational facility of the college's physical plant. This building of early New England architecture, with its walls three feet thick, is still in full use, serving students today after having withstood the ravages of nearly two hundred New England winters and two major fires.

To understand how the Williams College physical plant has developed over the years, it is helpful to know a few historical details. The founding President and Trustees chose the most prominent high ground near the center of the village to site the original building. The foundations for this structure were placed on rock ledge. They were constructed by excavating a rude ditch and carefully placing large stones into the void. On this base were built the load-bearing brick walls. West College remains today as a symbol of the solid foundation upon which the entire college has been built. It is immediately apparent to the campus visitor that this venerable building served as the forerunner of several other similar structures in the physical plant, all of them built with the solid foresight and architectural integrity envisioned by the founders. The architecture of these early buildings, as well

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*Submitted by Peter P. Welanetz, Director of Physical Plant

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as later buildings, has been a major contributor to "The Village Beautiful" sobriquet enjoyed by the entire town of Williamstown.

One of the most interesting features of the Williams College campus is that you can trace its long, tradition-rich history by the variety of architectural styles that were in vogue over the various decades. Very few buildings in its physical plant bear an exact resemblance to one another. Although there is perhaps a preponderance of Georgian design, still there are excellent examples of Gothic, Greek Revival, Post-Civil War, Early New England, and contemporary structures. Somehow this conglomerate of architectural styles works well together, presenting to the campus visitor a very attractive and substantial physical plant. The Williams campus strikes most prospective students as a place they'd like to live at and enjoy. It doesn't turn them off with the forbidding "institutional look" of so many educational institutions.

Was this happy result by design or by chance? Although only the period since World War II is well documented, it is obvious that hard campus-planning decisions were made at various intervals throughout Williams' long history. Since the college has enjoyed the services of a large variety of architects, its planning has been flexible and its building designs unconstrained by stereotyped architectural assumptions. An aerial photograph of the campus is shown in Figure 1.

The first century of Williams history saw a slow but steady growth in the number of its campus buildings. A significant increase took place from the turn of the century through the 1920s. Then during the 1950s and 1960s the gross square footage of the campus nearly doubled, bringing it to its present 1,850,000-square-foot total. Williams now has some 65 major buildings, 100 faculty housing units, and 450 developed acres of land in the main core of the campus. The college owns some 3,000 acres all told.

The Williams student body numbers 1,900. They are taught and served by a faculty and staff of just over 600. Since Williamstown itself has a population of only 8,000 people, obviously the college and town are inseparably linked economically and socially. For that reason a good deal of the planning for both Town and Gown over the years has been mutually conceived.

With a relative abundance of available acreage for campus growth, the hallmarks of campus planning have been simplicity, orderliness without exact symmetry, and an uncluttered look. Williams landscaping has emphasized open vistas, numerous sweeping lawns, large trees, and uncomplicated plantings. There are just enough paths and roads to service the buildings and conveniently carry the traffic. Actually, in recent years some sections of roadway have been eliminated and the areas restored to lawns.

Williamstown, the site of a prehistoric lake bed, sits in a bowl of scenic mountains. For this reason, the orientation and siting of college buildings has been done with great care to maximize the views.

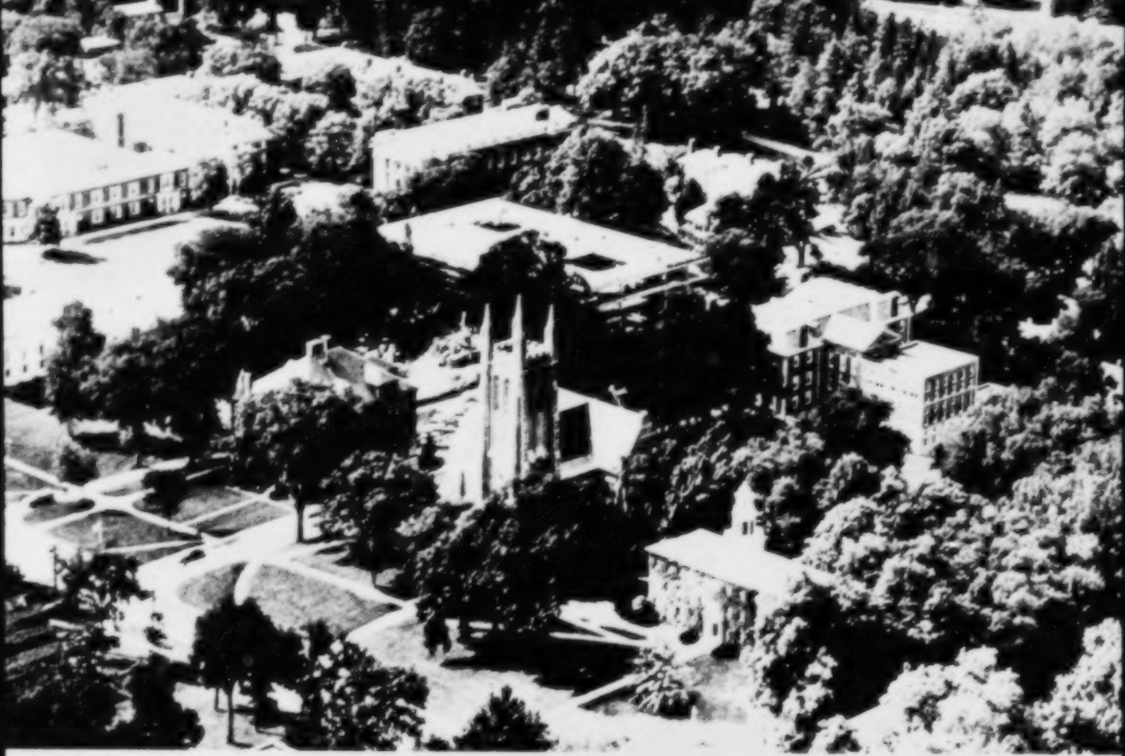

Figure 1. Williams College Campus, 1974

New England winters restrict types of plantings and trees that can be used on the campus. For the most part, foundation plantings are Japanese yews and juniper evergreens, but some deciduous shrubs such as euonymus and hardy azalea are used. The dominant tree on campus is the American elm. Its beauty and grace, its tremendous height, its foliage (providing shade without closing off views of the campus), all make it ideally suited for the small New England college. Dutch elm disease has taken its toll, but the college and the town have combined their efforts with some success in a constant fight to control the disease. We are continuing to plant young replacement elms in the hope that sooner or later American technology will find a fully successful method of controlling Dutch elm disease. A recently planted specimen is shown in Figure 2, along with West College and a 200-year-old elm.

As in the case of many institutions of comparable size, Williams has had a number of "master plans" developed by various architects and planners over the years. The most recent comprehensive plan was developed early in 1969 by Dan Kiley, a planner and landscape architect, Charlotte, Vermont. Mr. Kiley's master plan included a model of the campus, shown in Figure 3.

Williams College generally has followed its master plan, particularly with regard to the main axis, traffic patterns, and the siting of most buildings.

Naturally, any master plan is directly affected by the college's educational policies. For instance, it is doubtful that Williams will expand its student body very much in the foreseeable future. This stability will greatly lessen the pressures on physical plant that have been felt in recent years.

When Williams—traditionally a men's college—added women in the 1970s, its academic facilities could accommodate them with relatively little impact. On the other hand, coeducation had a noticeable influence on the planning of athletic facilities.

With the decision of the Trustees in 1962 to abandon a fraternity-based residential system in favor of a house system, the college faced the task of constructing several new student residential houses and of bringing the former fraternity properties into its physical plant. The main impact involved a major renovation program for these former fraternity structures. At the same time, however, that the shock of this dramatic change in social and residential patterns was taking place, the post-World War II baby boom forced the college to make some new additions to plant.

Throughout its expansion period, Williams was fortunate to have had well-thought-out utility systems, which made additions to plant relatively convenient. The original central-heating and electrical systems were exceptionally well designed. They have withstood the test of time very well with respect to adaptability and expansion.

Programming at Williams for new structures or major renovations is gen-

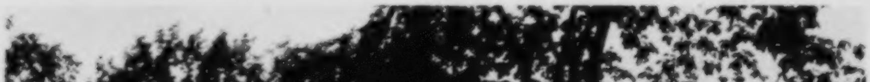

Figure 2. American elms, West College.

erally done by the academic department involved. Athletic buildings are programmed by the Athletic Department, and General Service and Housing buildings by the Administration. After a specific program has been developed, it is reviewed by the President and the Provost from an educational viewpoint, and by the Vice President for Administration and the Director of Physical Plant for cost and feasibility considerations. The President of the college plays the key leadership role in the preliminary planning for physical facilities, with the active involvement of the Trustee committees on Buildings and Grounds, and Budget and Financial Planning.

Since traditionally Williams has built its facilities with private funds, the Development Office is often brought into the planning process early. Currently capital funds are coming in slowly; and with an eye toward other economic and energy conservation considerations, the Trustees have placed a moratorium on new construction. For the next decade it is anticipated that the great majority of changes or improvements to the facilities will be in the form of renovations or alterations to existing facilities, with perhaps some modest additions to buildings to provide new space. Even these changes will occur only as funds become available for that specific purpose as well as for operating and maintaining the buildings.

Architects are usually chosen by a committee consisting of the President, the Vice President for Administration, the Provost, and the Director of Physical Plant. There's additional input from the Building Committee (if formed), the Art Department, or other concerned parties in the college community. Student input is also sought. Central administration makes the final decision. Often architects are chosen because of a particular type of building specialty or style in which they have had noteworthy experience and which appears to point to sound solutions for the building requirements. Williams has not as yet used the system of an architectural contest to select any particular architect.

Once the architect is chosen, the chairman of the Building Committee for the project, in close coordination with the Vice President for Administration and the Director of Physical Plant, transmits most instructions to the architect. When construction drawings are finally approved, the Director of Physical Plant or his assistant instructs the architect. He likewise maintains close coordination with the chairman of the Building Committee and the Vice President for Administration. All Building committees are ad hoc and are discharged after a particular project is completed.

The actual construction work is under the direct control of the Director of Physical Plant or a member of his staff that he may designate "resident engineer." All Williams buildings are of quality materials and construction, built for the long haul. Consequently, great emphasis is placed on the supervision and inspection of the actual construction by representatives of

Figure 3. Master model of Williams College campus.

Williams College. Some institutions hold the resident engineer directly responsible to the architect. At Williams, the Resident Engineer is responsible directly to the college. There is, however, close coordination with the architect.

Because of this type of supervision by Williams, most construction contracts are written on a "bid" basis. Rarely does Williams use "cost plus" or "negotiated bid" contracts. The college has never utilized a "management contract" on any project. Its system appears to have been very successful, judging by the obvious quality construction of its buildings.

As Williams moves into a new era of energy conservation and economic constriction, we will try to adjust to the problems these influences create in our planning and construction of facilities. We believe we can successfully meet these problems without sacrificing any of the solidarity of design or of the aesthetic values that have been created on this beautiful New England campus. Williams looks to the future with concern but is resolved to maintain the standards that the construction and maintenance of its physical plant reflect.

## Planning and Construction at University of Nebraska Medical Center*

The University of Nebraska Medical Center, located at Omaha, Nebraska, is one of the three campus units of the University of Nebraska system. The University is a State institution governed by a Board of Regents elected by the people of Nebraska and funded from tax revenue authorized by the State Legislature. The primary object of the University Medical Center is to provide educational opportunities for the young men and women of the State of Nebraska for undergraduate and graduate career choices in medicine, nursing, pharmacy and other allied health professions. Other objectives of the University Medical Center are to provide health services for the citizens of the State through the teaching hospital, which is a part of the University Medical Center, and to carry out research activities in furthering the medical careers of the students and faculty and the advancement of the health sciences.

After having existed as a private corporation since 1881, when it began with an all-volunteer teaching staff as the Omaha Medical College, the College of Medicine became a part of the University of Nebraska in 1902 with part of the instruction occurring in Lincoln. Since 1913 the entire four-year Medical course has been given on the Omaha campus.

A prominent Omaha architectural firm developed the first master plan in 1916, and during the period up to 1927 construction included the first two units of the hospital, a nurses' home, and two basic science buildings. During the period to 1947 the Campus Plan was developed as a comprehensive working plan and projected the development of land boundaries, roads, and

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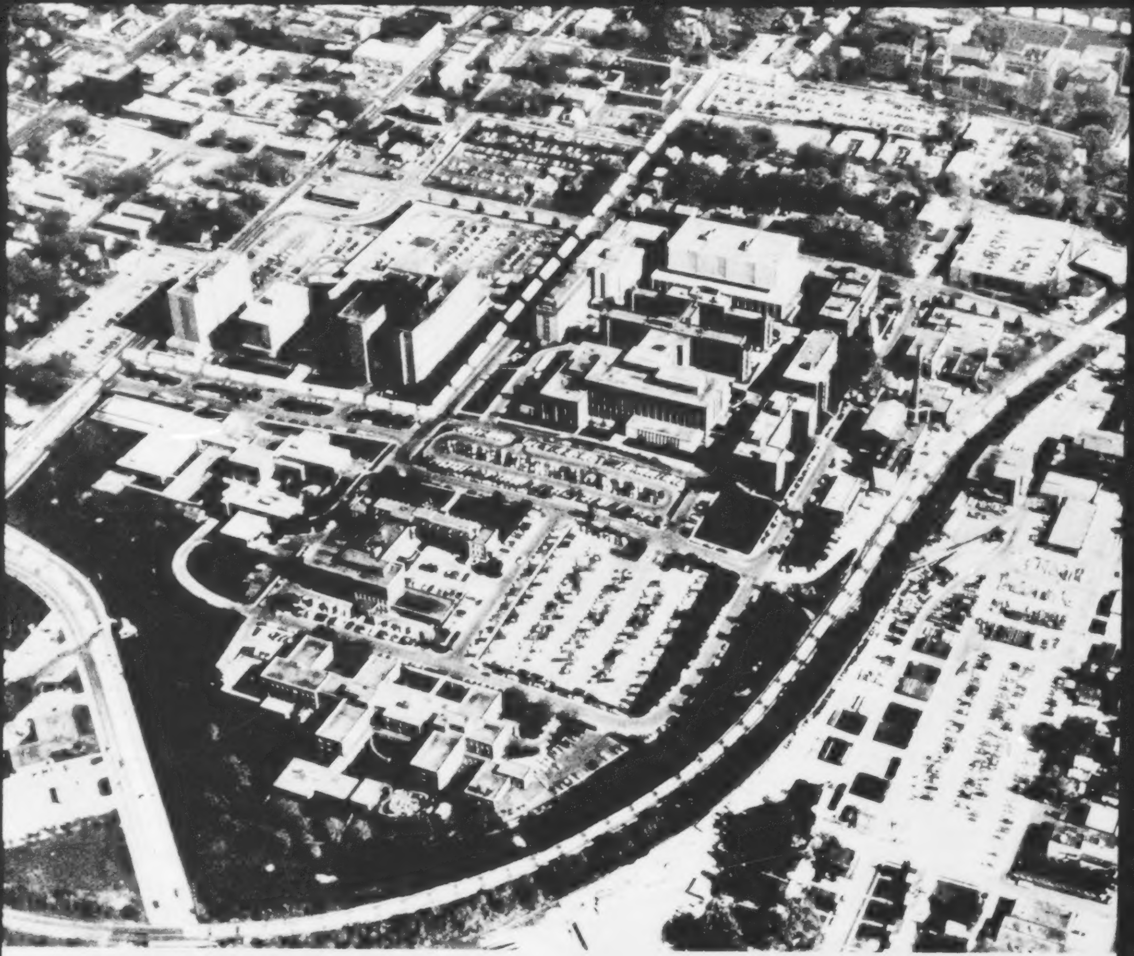
*Submitted by George C. Money, Director, Department of Physical Plant



University of Nebraska Medical Center, Omaha, Nebraska.

utilities distribution sized for future expansion; however, there was no major construction from 1927 until 1952.

When it became known that several private medical institutions contemplated moving to the vicinity of the Medical Center, it was apparent to all that the scope of the Campus Plan must be enlarged to incorporate affiliated institutions. The authors of the Campus Plan were commissioned to do preliminary studies to enlarge the hospital with assistance through Federal Grant-in-Aid programs. About this time the National Council on Medical Education was giving credit to medical schools for teaching beds in nearby accredited institutions. This policy had considerable impact for the future of the College of Medicine; money formerly needed to construct bed facilities could now be expended to enlarge teaching and research facilities. This happening, along with the anticipated location of several new facilities nearby, changed the entire concept from a medical school to a medical center.

About this time, in 1950, the State Legislature levied a small property tax with a fixed ceiling from which the Medical Center was required to finance deferred maintenance, remodeling, and capital construction up to about 1965. Since that time the transition from a marginal medical college to a full-fledged Medical Center has been completed. Virtually the entire Physical Plant has been rebuilt, and a modern 284-bed teaching hospital, a new basic sciences building, and one of the nation's finest medical regional libraries has been added. These facilities were crucial to major improvements to the programs of institution and research.

During the 1950s and early 1960s building committees working under the direction of the administration began planning and coordinating building projects on the Medical Center campus, but it may have been the impetus provided by the State of Nebraska to initiate a major program to upgrade facilities for the University Systems that accelerated the building program on the Medical Center campus. In the fall of 1975 the enrollment of students at the University of Nebraska Medical Center was 1,754 FTE. Approximately 3,000 people are employed at the Medical Center to support the colleges and the hospital. There are 1,500,949 gross square feet of buildings as a part of the Medical Center campus, with the utility plant providing utilities for 2,123,678 gross square feet of buildings, which include two private hospitals affiliated with the Medical Center for teaching purposes.

The procedure for Capital Planning and Construction has been developed by the Central Administration of the University Systems for their three campuses, with checks and controls established by the State Legislature.

Other campuses under the supervision of the University of Nebraska Board of Regents have retained architects to develop comprehensive plans, whereas the Medical Center has as its Physical Plant Director an architect who has as one of his responsibilities the development of Master Plans and Capital Construction. Working closely with the Committee for Long-Range Planning appointed by the Chancellor of the Medical Center and in conjunction with the Department of Administrative Services for the State of Nebraska, the Director of the Physical Plant prepares a long-range Capital Construction Master Plan projected to twenty-four years and a shorter-range Capital Construction Master Plan projected to six years. These plans assure the reaffirmation of the purpose, goals, and continuity of the programmatic projections of the institution together with the compliance with previous master plans. Each year a budget request for Capital Construction for the coming year is prepared and submitted through the Board of Regents to the Legislature, with the six-year plan being updated every three years, and the twenty-four-year master plan being updated every six years.

Because of the complex multidisciplinary nature of the Medical Center, multiple entry points exist for the idea phase of a capital project or program need. After appropriate reviews and entry into long-range planning, a meritorious idea is channelled into the development of a Program Need Statement to request funds for planning in the Capital Construction Budget process. The Need Statement, with input from multiple sources, supplies supporting data, objectives, and goals of the project, invites a critical review of the idea, and (if funds are granted) provides a base for the Program Statement. This is a detailed planning document that shows how the function and purpose of the program translate into a facility, projects utilization and assignment of individual areas, and reviews the budget (including the cost of construction, equipment, and utilities and the impact upon annual operating maintenance and programmatic costs).

After the Program Statement is approved, the Capital Planning Department of the Physical Plant prepares the Capital Construction Request through the budget process for design and construction. Although the primary source of funds is legislative appropriation, funds are also obtained from Federal Grants, foundations, and private sources, all of which are utilized in Capital Construction.

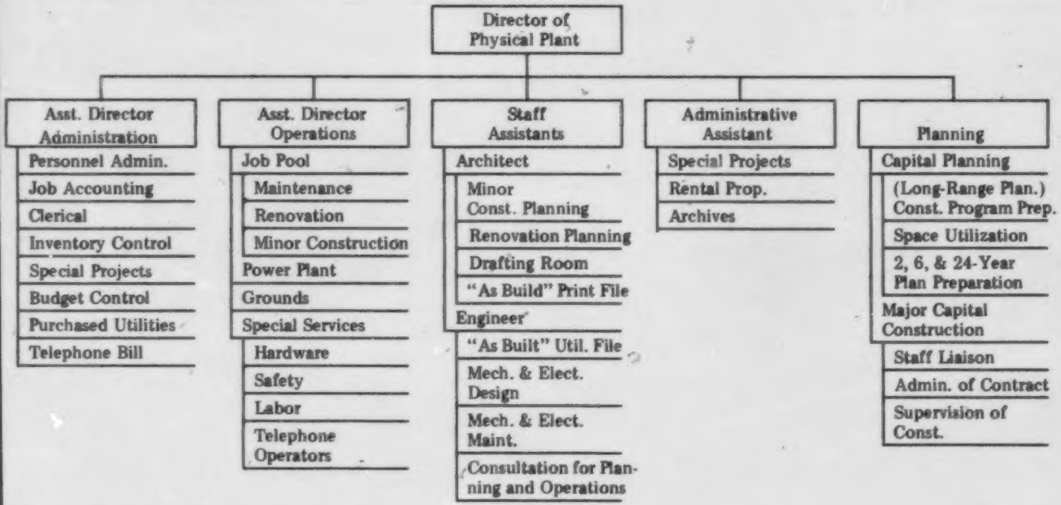
The procedure for the selection of the architect adopted by the Board of Regents provides that all registered State architect firms will be notified of University projects. Program Statements are provided to and proposals solicited from interested firms prior to evaluation by the University Systems Construction Coordinator and selection by the Board of Regents. The role of owner is then assumed by the Director of the Physical Plant as he works with the architect and the Program personnel through the progressive stages of Design Development Drawing, Construction Plans, Construction Bids, Awarding of Contracts, and Construction.

A procedure in outline form is included at the conclusion of the statement to illustrate Capital Planning and Construction at the Medical Center.

During the past ten years Capital Construction contracts totaling approximately thirty million dollars have added a million square feet to the total of over two million square feet of building area located on the fifty-five-acre Medical Center campus. Master Plans have defined the projected boundaries, which will make necessary the acquisition of a few small parcels of land. Programs based on needs to fulfill the mission of the Medical Center must be constantly evaluated, and Capital Construction will follow those needs. The presence of many program studies in the current plan indicates a high level of construction during the next few years.

The growth and responsibilities of the Physical Plant parallel the accelerated building program. The department is administered by a Director who reports to the Executive Director of Business and Fiscal Administration for the Medical Center. The staff includes registered architects and engineers (who are responsible for the design and construction of the ever-present

University of Nebraska Medical Center
Physical Plant Department


Director of Physical Plant
Asst. Director Administration
Personnel Admin.
Job Accounting
Clerical
Inventory Control
Special Projects
Budget Control
Purchased Utilities
Telephone Bill
Asst. Director Operations
Job Pool
Maintenance
Renovation
Minor Construction
Power Plant
Grounds
Special Services
Hardware
Safety
Labor
Telephone Operators
Staff Assistants
Architect
Minor Const. Planning
Renovation Planning
Drafting Room
"As Build" Print File
Engineer
"As Built" Util. File
Mech. & Elect. Design
Mech. & Elect. Maint.
Consultation for Planning and Operations
Administrative Assistant
Special Projects
Rental Prop.
Archives
Planning
Capital Planning
(Long-Range Plan.) Const. Program Prep.
Space Utilization
2, 6, & 24-Year Plan Preparation
Major Capital Construction
Staff Liaison
Admin. of Contract
Supervision of Const.

remodeling projects) as well as staff assistants in Capital Construction.

The Physical Plant Director assumes the additional responsibilities for Capital Planning and Capital Construction, and his presence on ad hoc, standing, and long-range planning committees together with representatives of other disciplines within the Medical Center assures the continual progress and success of the Capital Construction programs. The dual role as Director of Physical Plant and Director of Capital Planning may be neither unique nor unnatural, but it is both challenging and rewarding.

A public law for the State of Nebraska that was passed in 1969 established a Department of Administrative Services under the Governor's office for review of construction and planning for state facilities. It also prohibits a state agency from performing for itself any of the services normally performed by a professional engineer or architect unless the total project cost is less than $50,000.

### Planning and Construction at the University of Oregon*

In 1976 the University of Oregon celebrates the centennial anniversary of its founding. Established by an act of the Oregon Legislature in 1872, the University began offering classes to 177 students on October 16, 1876.

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*Submitted by Harold C. Babcock, Director, Department of Physical Plant

Today the University enrolls some 17,000 students and has some 1,300 faculty. It is one of only twenty-four public universities in the nation to be selected for membership in the American Association of State Universities. The curricula include thirty-five departments and special programs in the liberal arts; nine professional schools and colleges; twelve research bureaus, institutes, and centers; and a graduate division.

The University is funded primarily from state appropriations, specified sums from the federal government, and other income such as student tuition, fees, gifts, grants, sales and service charges. Its current biennial budget is $109,700,000.

The U of O has a 250-acre main campus in Eugene, an observatory at Pine Mountain in Central Oregon, and an Institute of Marine Biology at Charleston on the southern Oregon coast. The University has 44 major buildings, 73 minor buildings, and housing for over 750 married students. The Physical Plant has 235 full-time employees, 50 part-time employees, and 60 student employees. Its annual budget approaches $4,000,000.

The following discussion of the "Oregon Experiment" is authored by Robert S. Harris, dean of the University of Oregon School of Architecture and Allied Arts and an interested and involved participant in campus planning at the University for a number of years.

## The Oregon Experiment: Creation of an Orderly, Rigorous, and Continuing Planning Process

Part One: Context. Many University campuses have been planned at the inception of the institutions they support, many have been developed opportunistically, piece-by-piece over time, and some are facilities initially utilized for other purposes and now remodeled to serve academic programs. By now nearly all campus development is guided by some process, however effective, far-reaching, or short-term, and by some sort of physical layout of future construction.

Older universities, and their planners especially, have been impressed by the new campuses for community colleges and for a few new Universities that have been put in place virtually in toto and virtually at once. Many of the campuses appear to be pleasant, are certainly well-equipped, and seem to be free of problems such as parking and service that plague older campuses. But often they are also isolated from the communities they serve, are not any better adapted to changing educational programs than are the more established but no less rigidly organized older campuses. Indeed, many newer institutions have found their "master plans" no longer valid and are changing and expanding in patterns not visualized five or ten years ago. Institutions conceived as ever-expanding in size were planned so that their initial or core facilities could remain intact as new elements were added to the periphery. Basic academic departments were also expected to remain intact. The fundamental conflict between these assumptions is apparent. The departments at the core may grow, but additions can occur only at the periphery. Also, of course, if a new program is of central importance it can remain only at the periphery physically or must displace an existing program. Creating appropriate adjacencies is difficult and often is simply forsaken as an objective.

What has happened is that new campuses, as well as old, have been conceived in regard to a stable model of independent units, when all the best evidence discloses a dynamic model of interdependent units. The model most universally employed has been a simplistic zoning model inappropriate to the complexity and interconnections of the programs being served, and inappropriate on a campus where the social and financial regulating effects of zoning are unnecessary. The clarity and seeming rationality of a zoned master plan, with housing in one place, science in another, the arts in another, humanities in still another, and so forth, is deceptive. Furthermore, it masks the uncertainty of the political and financial processes on which such a plan depends.

Master plans schedule specific future events that seldom occur in the sequence expected or perhaps do not occur at all. The "best" examples of implemented master plans are virtually always private institutions, well-endowed, operated autocratically. For the master plan depends upon systematic and persistent, unflinching, pursuit of a preconceived image and end-result. Those among us who thrill to good old-time male assertiveness know that such unflinching pursuits hardly ever happen any more. For one thing, you have to run over a lot of people whose ideas differ from your own. You have to ignore a lot of information and opportunities you hadn't encountered initially. You have to live a long time in power with supportive colleagues. And you have to have a lot of confidence in your own vision. Probably, too, you have to be a part of a society with strong traditions and common values, which you are especially able to anticipate and implement. Most certainly you have to have a continuing, adequate, and dependable source of funding.

Public institutions are seldom run by autocrats these days. Nor have legislators ever been known as the most likely sources of continuing, adequate, and dependable capital. University departments and programs change in character and size. And University programs are often interdependent, such that change in one department effects changes in others. Thus, the master plan as a beautiful drawing rolled up on the shelf or stacked in the closet as interesting old brochures, can be understood as a popular but either useless or misleading device.

In 1962 the University of Oregon obtained planning advice in the form of an updated master plan from Lawrence Lackey, an urban design consultant. His reports contain some interesting studies as well as a "schematic campus plan." It was clearly based on zoning of activities, peripheral growth around an unchanged core, and on expansion of facilities for science, for academic programs, and for housing. Since that time several science buildings have been built in the areas designated by the plan. The same is true for the administration building, the library addition, and PLC. University and State System administrators have done their best to follow the plan. But the additional academic facilities that were planned to occupy the space of the cemetery have been deferred—as has been almost all other development for professional and non-science programs. The Law School is an unplanned exception. At any rate, by the late 1960s whatever elements of the plan that could be put in the places assigned to them had been undertaken; the plan offered no guidance as to what to do next. Authorization was requested and received to hire a new planning consultant to prepare an updated master plan.

The first step in employing a new planner was to develop a program for planning consultation. The University Planner, Larry Bissett, and several members of the Campus Planning Committee prepared such a document that was eventually used, after administrative review and Chancellor's Office review, as a basis for interviewing and selecting a consultant. Ten to twelve firms from all parts of the U.S. and from Canada were invited to be interviewed. All accepted and came to the campus at their own expense. Their interest, according to comments at the interviews, related to several important aspects of the program. Especially they responded to the University's interest as emphasized in the opening paragraph of the preamble of the document:

> *The overall objective of this study will be to recommend a development program which reflects the current and emerging education policy and is responsive to student, faculty, and staff input. This program must also be responsive to the existing physical environment and the programming and financing methods available to the University of Oregon, although other programming and financing methods may also be proposed.*

Although the program included a section required by the Office of the Chancellor that referred to a more conventional master plan, it was apparent to a number of the firms that the University was interested in a revised planning process, not merely a map. This partly reflected, but to a large degree anticipated, current understanding in the field of planning, and the program prepared by the University is the basis of what is now known as the

"Oregon experiment." The emphasis is not primarily on the location of new buildings; rather, it is on the means by which the whole of the campus can be continually adjusted to serve developing programs. Especially, the plan was to provide for improved programming and financing methods while continuing and improving the University's tradition of obtaining input from "students, faculty, and staff."

Eventually the Center for Environmental Structure, headed by Christopher Alexander, was selected. As the Center began its involvement with us in the fall of 1970, the following short list of theoretical assumptions was shared as a basis for the work:

1. The ecological model may be applied, meaning that everything has effects whether the effects are immediately obvious or not.
2. There is virtually no independence of systems; relationships are numerous and complex.
3. Attention is best given to fundamental and generative processes, not merely to objects.

Furthermore, from the tradition of the University of Oregon as well as from the preamble of the planning program it was expected that planning would incorporate input from those who would use the facilities. This had long been practiced in some limited form at the University of Oregon. And at the close of the sixties such participation was demanded. The question on the part of those who had experienced a generation of token urban-renewal citizen's committees, and the often patronizing efforts of advocacy planners, was how to incorporate users in the planning process in some way that would actually improve the results, not just placate the inhabitants. In 1970, especially on a college campus, it was hard for some to realize that participation could be desirable for apolitical reasons. However, members of the Campus Planning Committee knew that many planning difficulties and project delays were attributable to a lack, not only of information, but also of the insight that comes from sufficient consultation with actual building users. So the Oregon experiment needed also to include innovations in user participation.

Several other general developments in planning complete the context for the Oregon experiment. First, by 1970 a considerable body of knowledge was beginning to be developed in a new field being called "man-environment" relations. This knowledge related psychological and behavioral factors to environmental conditions. The research results had been difficult to apply in design of new facilities. Either the levels of generalization were too broad or the settings appeared too distinctive from each other. The University chose the Center for Environmental Structures because, among other things, they were leaders in developing a systematic means for relating behavioral findings to local contexts and to design guidelines specific enough to be useful. Alexander had been a leader in developing this approach since publication of two volumes nearly a decade earlier, one an analysis of housing entitled *Community and Privacy*, and the other a seminal theoretical treatise entitled *Notes on the Synthesis of Form*. Other important works accomplished prior to his employment by the University of Oregon included two projects, one related to housing and one to multiservice centers, both of which utilized planning policy instruments called "relational patterns." These instruments, as they are related one to another, form a structuring sequence of design understandings. In sequence they are called a "pattern language." The Oregon experiment also incorporates a systematic means, not only of obtaining user insights, but also of applying research findings.

The last of these major developments that form the context for the Oregon experiment relates to the evolution of planning models and of general theoretical structures for planning processes. Research in this direction is relatively new, almost entirely occurring after World War II, and most of it after 1960. Virtually every model developed during this period illustrates the shift away from fixed-image facilities planning. However, the least successful of the first generation of these new planning models included fixed objectives, of the sort successful in military and aerospace operations; thus, second- and third-generation models tended to avoid fixed objectives. The dominant development has been towards process-oriented policy planning, in which the basic effort has been to make both the decision-making processes and the generative or regulating policies explicit and public. Alternative policies are explicitly reviewed and their possible consequences modeled and inspected. A characteristic and rather successful practice has been to develop policies and to apply them to the probable development of the institution by creating numerous alternative "scenarios." Anticipating the probable effects of a policy allows open and intensive inspection of that policy and foreshadows probable future campus character. Current policies become concrete and "in focus"; future events and their sequence are speculative—as in reality. This is, quite clearly, the opposite of the master plan, in which the future events appear as concrete objects and the policies are often only implied. The Oregon experiment incorporates such a process—and policy-oriented decision model. It requires us to be responsible for our values and objectives now, and while continuing to hold them tentative, to inventively see to their implementation in each future circumstance as events occur.

Much controversy has surrounded emergence of the University of Oregon's new planning process, and considerable attention has been paid to Christopher Alexander as its author. While he has indeed been central to creation of the process and its patterns, the general approach should be seen in a context of ideas and developments within the field of planning and the general culture. But further, campus planning at the University of Oregon has been brought to the frontier of the field and we must realize that we are in a leading role in the transformation of planning practice. It is understandable that such a role would be controversial. It is also understandable that the University might deliberately and conscientiously develop unconventional practices in the face of clearly articulated problems and objectives—especially when conventional practice appears unsuccessful or inappropriate. Indeed, few will argue that campuses in recent times have been getting more beautiful, or more pleasant or that they serve better the activities they are intended to serve. The University of Oregon has embarked on an important journey in the history of planning. The Oregon experiment is being published by the Oxford Press for worldwide distribution (not at University or State System expense), and it is likely that for generations to come the leading persons in the field will want to visit Eugene to see the results first-hand. The flow of such visitors is already impressive and rewarding.

Part Two: The Six Principles of the Oregon Experiment. On October 31, 1973, the following motion was approved by the Campus Planning Committee and forwarded to President Clark:

*With the understanding that any adopted planning proposal will be subject to adjustment and development over time by its users,*

*and that the planning process proposed for the University of Oregon by the Center for Environmental Structure especially allows and requires the University community to continually review and creatively adapt both the process and the substance of the plan as circumstances and conditions may require,*

*and that the proposal includes fundamental and useful principles for planning as well as desirable and necessary conditions for a vital campus and University,*

*the Campus Planning Committee recommends formal adoption of the fundamental principles of "The Oregon Experiment" as the basis for the planning process for repair and development of the campus of the University of Oregon.*

The principles may be briefly set forth, although the weight of evidence and the subtlety of understanding that supports them requires a more lengthy and careful treatment.

1. *The principle of organic order.* Beautiful and life-supportive places have been created in the past, not because of the guidance of a master plan, but

rather through the shared traditions and understandings among their builders, the citizens of the community. The master plan imposes a preconceived arrangement and may be enforced, but cannot help to build common and deep understandings of the meaning and significance of the campus. Instead, growth and change, development of the campus, should be guided by explicitly debated and approved basic policies, called "patterns," which will serve to create a new shared language. Every project, however large or small, will be able to incorporate this structure of understandings, and thus contribute to reintegrating and improving the whole of the campus. This pattern language is itself subject to improvement and development over time; thus, as the policies are reviewed and adjusted, the formative power of the patterns will remain alive and responsive to new knowledge and to direct experience.

2. *The principle of participation.* No matter how diligently a supervisor attempts to understand the operational requirements and the experience of an employee, a qualitative difference will remain in relation to the employee's own views. The design consultant who is much further removed from the day-to-day experience of that same employee is also in much greater need of a means for "closing the gap." Interview techniques have not been qualitatively effective. And user review of developed designs often poses an overwhelming burden of sorting out issues and relationships that are complex, numerous, and subtle, whether appropriate or not. Direct participation of users in the design activity itself is effective and possible through use of the patterns. Moreover, design always poses questions that go much deeper than how to create an envelope for a set of activities. The act of building is a commitment to a set of human relationships and implies agreement to continue engaging in certain activities. Direct participation of users allows direct engagement of issues pertaining to the future of the organization, its social and operational structure, and the values that underlie its existence. Although every building project is a potential crisis when the persons with whom the project is associated face each other and their own futures, this cannot be done for them by an outside consultant. Nor are there shortcuts to ease the pain and joy of what usually is intense human interaction.

3. *The principle of piecemeal growth.* An extensive campus requires continuous adaption and nurturance, not just the occasional intrusion of massive new structures. The overall supportiveness of the physical environment can be assured only by committing funds to very many small projects that serve to keep the environment "in tune." Of course, the need for large projects may also occur. Thus, it seems reasonable to expect that funds for campus

development will be divided almost equally among large, intermediate, and small projects. In this way the campus will be developed, not by dramatic, large-scale projects, but by repair and rehabilitation, by remodeling, and by additions that gradually will create a fabric incorporating the policies desired by the University community.

4. *The principle of patterns.* A group of "global" patterns can be adopted by the community to guide the design of each project. The collection of formally adopted patterns can be reviewed annually, changes made, new patterns added, and some old patterns removed. But the standard for such patterns is high, requiring that changes be made only on the basis of explicitly stated observations and experiments. The patterns represent a body of knowledge applicable to the design of human settings.

5. *The principle of diagnosis.* It is possible to monitor the well-being of the campus by conducting annual or biennial diagnoses to determine which places are functioning well and seem alive and supportive, and which are underused or overused and seem either oppressive or dead. These diagnoses can then serve to guide the establishment of priorities for the use of project funds. In general, places that are found supportive should be left alone and the funds used to correct difficulties. The diagnosis will also record which places are already sound, but could become truly beautiful.

The diagnosis provides the overview of a master plan, without the prescriptive and preconceived rigidity that makes such plans totalitarian. In revealing the locations of current need and of opportunity, it leaves to the moment of action the responsibility for judgment and invention suited to each circumstance.

6. *The principle of coordination.* Although the patterns represent a community understanding and agreement, and although the diagnosis provides a campus-wide overview, a deliberate and dependable process must exist to coordinate the separate projects and to assure funding of projects of every size. A planning board can be charged with such a responsibility and can promulgate rules and procedures to improve the quality of project proposals.

### Planning and Construction at Brigham Young University*

Brigham Young University is owned and operated by The Church of Jesus Christ of Latter-day Saints. It was founded in 1875 with an enrollment of 29 students. It now has an enrollment of 25,000, making it the largest private church-related university in the United States. The school grew slowly: between 1875 and 1950, only 550,911 square feet of buildings had been constructed and of that 176,664 square feet were in temporary structures.

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*Sam F. Brewster, Director of Physical Plant (retired)

By 1950 students were clamoring for admission to the University, and further enlargement of its physical facilities became necessary. Some rush construction was done in the next few years, but it was apparent that a greater effort would have to be made if the development of the University were to stay ahead of its actual and projected enrollments. At this point, many decisions had to be made. A lot of those decisions had to do with matters pertaining to the academic side of the University—decisions as to the colleges to be established, courses to be offered both on the graduate and undergraduate level, additional faculty and staff, and so on. But among all the problems, certainly the need for additional physical plant was not the least. To get adequate buildings and other physical facilities in time to serve the rapidly expanding student body required quick, decisive action. The following are some immediate steps that were taken:

1. Early in 1957 the President appointed a committee of seven men to prepare a written report on the physical needs of the University in order that it might care for an enrollment of 15,000 students. (Later this ceiling was raised to 20,000 students, and in 1970 it was raised to 25,000, where it has remained.) This committee included three University personnel: director of Auxiliary Services, director of Campus Planning and Development, and superintendent of Physical Plant. Two private architects, a private landscape architect, and a private planning consultant were the other committee members. The committee made its report in August 1957.
2. The Department of Campus Planning and Development was abolished, and its responsibilities were given to the Department of Physical Plant. A new director of the Department of Physical Plant was employed in October 1957, and the department was reorganized to put greater emphasis on planning and construction.
3. A Campus Planning Committee of five men was appointed by the President. Its members were the director of Auxiliary Services, the dean of the College of Physical and Engineering Sciences, the chairman of the Department of Industrial Education, a professor of physics, and the director of Physical Plant, who was named chairman of the committee. The broad duties of the committee were to interview and recommend architects and engineers, review all plans for campus development, and, when satisfied with the plans, recommend their acceptance to the President of the University.
4. A comprehensive "master plan," which had already been started was quickly restudied, broadened in scope, delineated, and presented to the President. This plan was approved by the Board of Trustees in November 1957.

The main campus of Brigham Young University, July 1976.

5. In the Department of Physical Plant a planning section was established under a chief of planning who was responsible to the director of Physical Plant for the supervision and administration of personnel assigned to the section. The planning section was specifically responsible for maintaining the campus master plan, record drawings, preparing plans and specifications for alterations and additions, planning for site-development work, writing building programs and preparing preliminary architectural studies, models, print reproductions, and utility and planting plans.

6. In the Department of Physical Plant a construction section was established under a construction engineer who was responsible to the director of Physical Plant for the supervision and administration of personnel and work assigned to the section. The construction section was made responsible for the review of plans and specifications prepared by other Physical Plant personnel and by all professional architects and engineers doing work for the University. This included seeing that all supervisors and foremen of the various shops in the Department of Physical Plant and the other specialists in Physical Plant reviewed their particular sections of all plans and specifications. The construction engineer was made responsible for combining all these reviews into written reports which were given to the director of the Department of Physical Plant. The construction section was also made responsible for all architectural, mechanical, electrical, structural, and other technical inspections to be done on all major or assigned construction work on the campus.

7. A determination of major construction projects that were to be given early consideration was made.

8. Ad hoc committees were formed to work with the Campus Planning Committee and with the Department of Physical Plant in the preparation of "written programs" for the guidance of the architects and engineers selected for the several projects.

9. The Campus Planning Committee reviewed architectural and engineering firms and recommended to the President the architects and structural, mechanical, and electrical engineers for those projects to be started immediately.

10. The Staff of the Department of Physical Plant prepared a set of "Instructions to Architects and Engineers" that was given to each firm of architects at the same time that they were given "written programs" for their respective jobs.

11. Engineers were employed to plan the additions and extensions to all campus utilities. Major extensions had to be made to the high-temperature water-distribution system, the sanitary sewer system, the culinary water system, and the electrical-distribution system. In addition, an entirely new storm-sewer system had to be planned.

12. Plans and specifications were prepared for the peripheral road around the main campus, for other streets, and for several parking lots.

13. Because much of this projected work was to be done in areas occupied by temporary buildings, it was necessary to prepare a very careful study to determine whether a temporary building could be removed entirely and its occupants taken care of in other buildings while the new facility was being prepared, or whether the temporary building would have to be moved to a location where it could remain until it was no longer needed. As all facilities

were heavily used, this was a difficult problem. But with careful planning and the excellent cooperation of everyone concerned, it was done with a minimum of interference to the teaching schedule of the University.

14. Because much of the new construction was to be done in heavily used portions of the campus, it was necessary to give careful thought and planning with reference to where contract limit lines would be set. A system of fences and temporary construction roads was constructed in such a way that University personnel would not interfere with the contractors, and contractors would be entirely fenced off from all normal University functions.

15. To speed up the preparation of working drawings and for other reasons, five firms of architects were awarded contracts. While these firms were not connected in any way with each other, it was necessary to associate them loosely to ensure a harmonious whole instead of a collection of unrelated buildings. The cooperation of the architects and the results obtained were very satisfying. Each architect was able to put his own ideas into his buildings; but by use of previously agreed upon materials and some standard details, the buildings—while maintaining their own character and individuality—do harmonize very nicely. (This is where a written program on each building and a standard set of instructions and suggestions to the architects and engineers pay off.)

Since those hectic days in the late 1950s and early 1960s, much planning and construction work has been done. But the basic concepts established back in 1957 and in 1958 have been followed to a remarkable degree. During the centennial year of 1975, the Physical Plant consisted of 5,672,753 square feet in use and 537,623 square feet under construction. Brigham Young University has a planned campus of functional and pleasing buildings attractively landscaped and well maintained.

The development and operation of the University has been accomplished entirely from funds made available by The Church of Jesus Christ of Latter-day Saints, revenue-producing activities, student fees, grants, gifts, and donations, and the University development fund.

The Department of Physical Plant has grown in size and in responsibilities as the University has grown. However, its basic organization in 1975 is the same as it was when established in October 1957. The department is administered by an assistant vice-president for Physical Plant who reports to the executive vice-president of the University. The department has a division of planning and construction under the direction of a professional engineer. The division is divided into a planning section and a construction section. The planning section is under the direction of a registered professional architect, and the construction section is composed of engineers and well-qualified building inspectors.

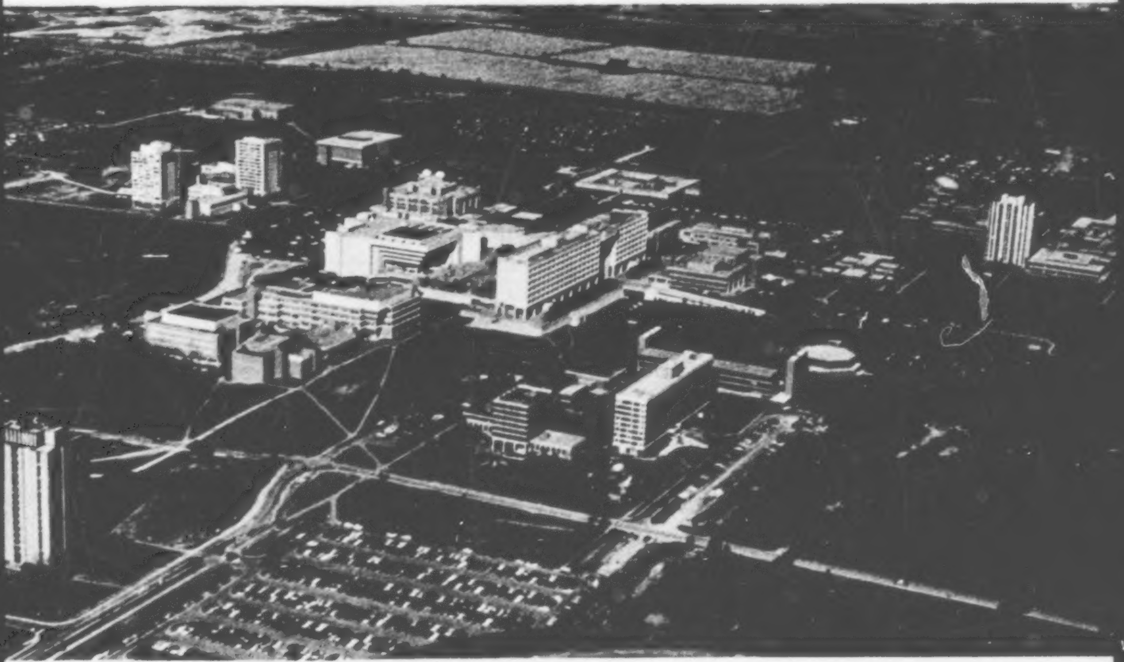
The Department of Physical Plant is recognized on the campus as a professional organization that has produced satisfactory results over the past eighteen years and often under great pressures. And there is no inclination on the part of the University administration to return to separate departments of campus planning and of physical plant.

## York University (Ontario, Canada)*

York University consists of three segments, one of which is the York Campus, or main campus. The second is Glendon Campus, the original home of the University and presently an 82-acre site consisting of six academic and service-oriented buildings and two residences, operated as a bilingual (English and French) unit. The third segment is Atkinson College, which operates from both campus locations and is a pioneer in the adult-education system.

York Campus was developed around a college system, in which all undergraduates, whether living on or off campus, would belong to a college. This system was developed as a humanistic device to give a student an identity

York University Campus, Toronto, Canada, 1975.



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*Submitted by John K. Armour, Director of Physical Plant within a college before relating to the main student group. The student's first year would be a general liberal-arts-oriented program; in the ensuing years college ties would gradually lessen as the student followed an individual specialty.

York Campus is situated on a 568-acre tract of land, as shown by the accompanying photograph, on the northern boundary of Metropolitan Toronto. This campus presently consists of thirty-seven buildings of which twenty-six are academic and service oriented and eleven are residences. There is a total of 3,789,000 gross square feet of buildings with a 2,806 FTE support staff, 1,320 FTE teaching staff, and a 1975/76 student enrollment of 14,552 FTE.

# Appendix C: Forms, Charts, Contracts, etc.

Forms and contract documents are a most important part of any planning and construction program. When carefully prepared, and approved by legal counsel, they can expedite work and, equally important, can prevent misunderstandings and legal involvements.

The following examples are far from comprehensive. The author requested a number of schools to submit their forms and similar documents. The result—a deluge that filled two large file boxes. Obviously it is impractical to reproduce forms and contracts several pages in length. The documents that are reproduced here are fairly typical and representative of the variety of documents currently in use.

From the response it seems obvious that the planning and construction offices of all schools have developed their own forms, contracts, and agreements. However, much can be learned by observing what others have done. Perhaps the following examples will suggest new or better procedures.

Form #CR-11
5/7/66

UNIVERSITY OF ARIZONA

OFFICE OF THE VICE PRESIDENT AND TREASURER

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CONTRACT BETWEEN OWNER AND ARCHITECT

THIS CONTRACT made and entered into this _____ day of ______________, 19_____, between the ARIZONA BOARD OF REGENTS, hereinafter called the Owner, and ______________________________________________________________ ____________________________________, referred to hereinafter as the Architect, under the terms of which the Architect agrees to perform the architectural services hereinafter set forth for the construction of ____________________ ______________________________________________________________ ______________________________________________________________ at the University of Arizona, Tucson, Arizona, hereinafter called the Project, and the Owner agrees to pay the Architect for his services the percentages of the construction cost of the Project prescribed in Section 34-104, Arizona Revised Statutes and hereinafter specifically recited.

The architectural services to be performed by the Architect shall include necessary conferences with the Owner's Project Committee and the Director of Physical Plant of the University of Arizona; the preparation of preliminary sketches and tentative design; preparation of complete working drawings, specifications and details of all aspects of the Project, including large scale and full size detail drawings for the structural, architectural, electrical, plumbing, heating, cooling, and other mechanical work; furnishing the Owner with an estimated cost of the Project (which shall not be considered as a guarantee of its cost); aiding in the drafting of proposal forms and contracts if requested by the Owner; supervision of the construction of the Project, and guarding the Owner against defects and deficiencies in the work of the Contractor; preparing change orders and assembling written guarantees required of the Contractor; and issuing certificates for payments to be made by the Owner to the Contractor according to the terms of the construction contract.

Supervision of the construction of the Project by the Architect shall include periodic visits to the site for the purpose of determining the quality of the work and whether it is proceeding in accordance with the terms of the construction contract between the Owner and the Contractor. The Architect shall keep the Owner informed of the progress of the work, and shall report to the Owner work which fails to conform to the contract requirements and condemn such work.

Certificates of the Architect for payments to be made to the Contractor, under the terms of the construction contract between the Owner and Contractor, shall constitute a representation by the Architect to the Owner that the work has progressed to the point indicated, and that to the best of the Architect's knowledge and belief, the quality of the work completed to that date is in accordance with the provisions of the construction contract.

The Owner shall pay the Architect for his services a total of 6% of the construction cost of the Project, as hereinafter defined, divided as follows: 1-1/2% for preliminary sketches and tentative design; 2-1/2% for complete working drawings, specifications and details; and 2% for supervision of construction. The first payment is to be made to the Architect upon Owner's acceptance of the preliminary sketches and tentative design; the second payment upon Owner's award of the construction contract; and the final payment within forty-five days after completion of the Project.

If the proposed Project is abandoned through no fault of the Architect, he is to be compensated by the Owner upon the percentage prescribed in Section 34-104, Arizona Revised Statutes for the services he has performed prior to the abandonment of the Project.

The Owner shall advise the Architect as to maximum amount of money available for the Project; provide him with a survey of the building site, if this is needed; furnish him with information as to the gas, water, sewer and electrical services; and pay for borings and other tests at the site, should these be required.

Drawings and specifications for the Project remain the property of the Architect whether the work for which they are made is executed or not, and are not to be used on any other work except by agreement with the Architect, but upon completion of the Project the Architect agrees to furnish to the Owner reproducible transparencies of the "as-built" plans.

"Construction cost of the Project," as herein referred to, means the final cost of the Project to the Owner, but does not include the Architect's fee for his services, or any other architectural, engineering or consultant fees or reimbursements, nor the cost of a project inspector, should one be employed. If labor or material is furnished by the Owner, the cost thereof shall be computed by the market cost of the material and the prevailing local wage rate for such labor.

This contract shall not be subject to assignment either in whole or in part by either the Owner or the Architect without the written consent of the other.

Witness our hands this day and date first above written.

| | |
|---|---|
| | Arizona Board of Regents |
| ______________________________<br>Architect | ______________________________<br>Owner |
| By: ____________________________ | By: ____________________________ |
| ______________________________<br>Title | Vice President & Treasurer<br>University of Arizona |

## INDEPENDENT CONSULTANT AGREEMENT

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, a California Corporation (hereinafter called "University"), do hereby retain ____________________

______________________________________________

(hereinafter called "Consultant"), whose business address is

______________________________________________

to furnish certain consulting services upon the following terms and conditions:

1. Consultant shall furnish the following described services:

    a. Act as a consultant to the Los Angeles ____________________

    ______________________________________________

    ______________________________________________

    to perform ______________________________________

    ______________________________________________

    ______________________________________________

    ______________________________________________.

    University will issue written authorization designating the specific services desired. Each such authorization will state the particular area concerned, the services to be performed, the schedule for their completion, and the estimated cost of such services.

    b. Hire the services of University approved consultants other than those employed or retained by Consultants.

    c. Furnish surveys, printing and reproductions as required and authorized by the University.

2. The period of service shall be from ____________________ to ____________________ and may be extended by mutual agreement of the parties. Either the University or the Consultant may terminate this Agreement at any time upon five (5) days written notice.

3. The University will pay fees to Consultant for services performed hereunder computed as follows:

    a. A maximum payment shall be established for each individual authorization which shall not be exceeded without prior written approval of the University.

    b. Payment to Consultant shall be made monthly subsequent to the receipt of a breakdown of costs for each individual authorization for the month billed.

    c. ______________ dollars (          ) per hour for the principal of the firm.

    d. For employees' time expended on the project remuneration shall be computed at a multiple of 2½ times the direct payroll cost paid by Consultant to his employees. Reimbursement rate for employees' time shall not exceed the schedule of payment for principal for similar services. The term "direct payroll cost" is defined as gross wages, including legally required applicable taxes (Federal, Social Security, unemployment insurance premiums) but shall not include employer contributions to fringe benefits, health or insurance premiums, vacation or sick leave, bonus or incentive payments or other employee expenses. No time of principal shall be charged under the provisions of this paragraph, except that should a principal provide drafting or other services normally provided by an employee, the principal shall be reimbursed at the same rate as his highest paid employee.

    e. The cost of consultants contracted with or employed pursuant to Paragraph 1b by payment of an amount equal to the amount paid by Consultant for the services of such consultants. Fees for any such consultants shall be approved in advance by University and reimbursement for the expenses of consultants' employees shall not exceed two and one-half (2½) times the direct payroll cost paid by the consultant to such employees for said services except that the rate shall not exceed the schedule of payment for principal for similar services. Direct payroll cost shall be as defined in Paragraph 3d.

    f. Reimbursement for direct cost, when accompanied by vouchers, for the following:

        (1) Printing.

        (2) All reproduction.

        (3) Expense of transportation and living when traveling outside the Los Angeles area subject to the same conditions as are in effect for employees of University, provided that such travel shall be authorized in advance by the University.

    g. Compensation for extra services, if required, shall be separately negotiated. In the event of termination prior to completion of the services to be performed, the University will pay said fees prorated according to the progress of the work, as determined by the University. The Consultant's Employer Identification Number is: ____________________.

4. The Consultant shall perform the services hereunder as an independent Contractor and not as an agent or employee of the University.

5. The Consultant shall not assign the performance of this Agreement, nor any monies due hereunder, without the prior written consent of the University.

6. Drawings, calculations, test results, recommendations, contract documents, renderings, exhibits, models, prints and photographs or other materials furnished by the Consultant hereunder shall be and remain the property of the University.

   Reuse of the design and/or corresponding contract documents or portions thereof by the University without additional compensation to the Consultant shall be limited to the University of California.

7. In the performance of this Agreement the Consultant will not discriminate any employee or applicant for employment because of race, sex, religion, color or national origin including, but not limited to: Employment, promotion, demotion, recruitment, recruitment advertising, layoff, termination, rates of pay and selection for training, including apprenticeship.

8. The Consultant is to cooperate with other Professionals employed by the University for the design of other work related to his services. The Consultant shall contract for or employ at his expense such professional consultants as he deems necessary for completion of the services, subject to approval by the University. Nothing in the foregoing procedure shall create any contractural relation between University and Professionals employed by the Consultant under terms of this Agreement.

9. The Consultant's books and records pertaining to the project shall be kept according to generally recognized accounting standards and shall be available to the University or authorized representatives at mutually convenient times.

10. If Consultant transacts business as an individual, his death or incapacity shall automatically terminate this Agreement as of the date of such event, and neither he nor his estate shall have any further right to perform hereunder. The University shall pay Consultant or his estate the prorated unpaid compensation due under Article 3 for any services rendered prior to such termination. If there be more than one partner and any one of them die or become incapacitated and the others continue to render the services covered herein, the University will make payments to those continuing as though there had been no such death or incapacity and the University will not be obliged to take any account of the person who died or became incapacitated or to make any payment to such person or his estate. The provisions shall apply in the event of progressive or simultaneous occasion of death or incapacity among any group of persons named as Consultant herein, and if death or incapacity befalls the last one of such group before this contract is fully performed, then the rights shall be as if there had been only one Consultant.

11. Notices

   Any notice may be served upon the University by delivering in writing addressed to the Campus Architects and Engineers, University of California, Los Angeles Campus, Los Angeles, California 90024, or by depositing it in a United States Mail Deposit Box with postage fully prepaid and addressed to the University at the above address and to the Consultant by delivering it in writing addressed to ______________________________________, or by depositing it in a United States Mail Deposit Box with postage thereon fully prepaid.

IN WITNESS WHEREOF, the parties have executed this Agreement dated ______________________________.

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

By______________________________

Campus Architect

CONSULTANT

By______________________________

## ADVERTISEMENT FOR BIDS

Subject to conditions prescribed by the undersigned, sealed bids are invited for the following work:

On ______________________________, at ____________:____________, Construction Documents will be issued to intending bidders upon deposit of $____________ per set at the ______________________________________________

______________________________________________________________

Checks for deposit to be made payable to The Regents of the University of California. The deposit will be refunded to each bidder and/or non-bidder upon returning such set promptly and in good condition.

Bids will be received only at ______________________________________ ______________________________________________________________.

No bids will be received after ______________________________________.

Bids will be opened at ______________, on ______________________________,
at ______________________________________________________________.

The Owner reserves the right to waive any informailities or to reject any or all bids.

Each bidder must deposit with his bid, security in the amount, form and subject to the conditions in the Information for Bidders. Attention of bidders is particularly called to the requirements as to condition of employment to be observed and minimum wage rates to be paid under the contract.

No bidder may withdraw his bid within 60 days after the actual date of the opening thereof.

Prospective bidders and their intended subcontractors are invited to attend a Prebid Conference for the purpose of informing all prospective bidders of the requirements of acceptable Affirmative Action Programs as provided in the Information for Bidders, on ____________________________, at __________,
at ______________________________________________________________.

Prior to award, the apparent low bidder and his listed subcontractors will be required to attend a Preaward Conference for the purpose of ascertaining that their acceptable Affirmative Action Program can be achieved as provided in the Information for Bidders. The apparent low bidder shall invite representatives from all unions which may be affected by Affirmative Action requirements of the contract to attend the Preaward Conference.

THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

Date: ____________________

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## NOTICE TO CONTRACTORS OF INTENT TO RECEIVE BIDS

Sealed bids will be received until 4:00 PM, Thursday, January 16, 1975, by the Arizona Board of Regents in the Office of the President, Room 712, Administration Building, University of Arizona, Tucson, Arizona, 85721, for the furnishing of all labor, material, transportation and service required for REPLACEMENT OF COMBUSTION CONTROLS ON CAMPUS BOILERS on the Campus of the University of Arizona, Tucson, Arizona 85721, in accordance with plans and specifications on file in the office of John B. Trimble, Director, Division of Physical Resources, University of Arizona, Tucson, Arizona 85721.

Bids will be opened publicly in the Regents' Board Room, 7th Floor, Administration Building, University of Arizona at 4:00 PM, Thursday, January 16, 1975, and read aloud by a representative of the Arizona Board of Regents.

Plans and specifications for the proposed work may be inspected at the office of the aforesaid DIRECTOR, or copies may be obtained by making a deposit of $10.00, which deposit will be refunded upon the return of plans and specifications in good condition within ten days after the opening of bids.

A certified or cashier's check or a surety bond for five percent (5%) of the amount of the bid must accompany each proposal, as a guarantee that the contractor will enter into a contract to perform the proposal in accordance with the plans and specifications or as liquidated damages in the event of failure or refusal of the contractor to enter into the contract, which check or bond will be returned to the unsuccessful bidders, and to the successful bidder upon the execution of a satisfactory contract and bonds, as prescribed by Arizona Revised Statutes.

It shall be mandatory on the contractor to whom the contract is awarded, and upon any subcontractor under him, to comply in every respect with the provisions of Titles 23 and 34, Arizona Revised Statutes, and with all other requirements of the laws of Arizona, applicable to contracts for the construction of public works, and to pay not less than the general prevailing rate of per diem wages in the area for each craft or type of workman or mechanic needed to execute the contract, which prevailing scale of wages has been ascertained from and certified by, the Industrial Commission of Arizona, a certified copy of which is on file in the office of John B. Trimble, Director, Division of Physical Resources, University of Arizona, Tucson, Arizona 85721.

The contractor to whom the contract is awarded shall, within five (5) days after the awarding of the contract, furnish to the aforesaid Arizona Board of Regents satisfactory performance and payment bonds in the form prescribed by Arizona Revised Statutes in the amount equal to one hundred percent (100%) of the full amount of the proposal. The performance bond shall not be limited as to time in which action may be instituted against the surety company for possible non-performance by the contractor.

Work shall commence within ten (10) days after the award of the contract and shall be completed within Ninety (90) calendar days from the starting thereof.

The Arizona Board of Regents reserves the right to reject any or all proposals or to withhold the award for any reason it may determine, and also reserves the right to hold any or all bids for a period of thirty (30) days after the date of the opening thereof. No bidder may withdraw his bid during this thirty (30) day period.

ARIZONA BOARD OF REGENTS

____________________
President

____________________
Secretary

Publish: Mesa Tribune
January 8, 9, 10, 11,
13, 14, 1975

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## RECEIPT FOR ADDENDUM

Date __________________________

Project __________________________

Project Number ________________________

We acknowledge receipt of Addendum No. _________ dated ________________________ on Brigham Young University's ____________________________________ (Project Name).

Firm________________________

By__________________________

Title________________________

Address______________________

## SECTION 2-E

## UNIVERSITY OF MAINE

## CONTRACT AGREEMENT - SHORT TERM

THIS AGREEMENT made the __________ day of ____________ in the year Nineteen Hundred and _________ by and between University of Maine duly authorized and empowered by virtue of the laws of the State of Maine, hereinafter called the Owner and ______________________________________ ______________________________ hereinafter called the Contractor.

WITNESSETH,

That the Owner and the Contractor for the considerations hereinafter named agree as follows:

### ARTICLE 1. SCOPE OF THE WORK

The Contractor shall furnish all of the materials and perform all the work shown on the drawings and described in the Specifications entitled

______________________________________________________________

Prepared by ___________________________________________________ acting as and in these Contract Documents entitled the Architect and/or Engineer; and shall do everything required by this Agreement, the General Conditions and Special Provisions of the Contract, the Specifications and the Drawings.

### ARTICLE 2. TIME OF COMPLETION

The work to be performed under this Contract shall be completed on or before ____________________________.

### ARTICLE 3. THE CONTRACT SUM

The Owner shall pay the Contractor for the performance of the Contract, subject to additions and deductions provided by approved change orders in current funds as follows ________________________________________

______________________________________________ ($______________).

### ARTICLE 4. CONTRACT BOND

The Contractor shall furnish the Owner the approved Contract Bonds (as per Article 23 of the Standard General Conditions) in the amount of 100% of the Contract sum

### ARTICLE 5. PROGRESS PAYMENTS

The Owner shall make payments on account of the contract as provided therein as follows: Each month 95% of the value, based on Contract prices of labor and materials incorporated in the work and of materials suitably stored at the site thereof up to the first day of that month, as certified by the Architect and/or Engineer.

The Owner may cause contractor to be paid such portion of the amount retained hereunder as he deems advisable. (See Article 19 of the Standard General Conditions).

### ARTICLE 6. FINAL PAYMENT

Final payment shall be due 60 days after completion and acceptance of the work, provided the contractor has submitted evidence satisfactory to the Owner that all payrolls, material bills and other indebtedness connected with the work has been paid.

### ARTICLE 7. THE CONTRACT DOCUMENTS

The General Conditions of the Contract, Instructions to Bidders, the Proposal, the Special Provisions, the Specifications and the Drawings, together with this agreement, form the Contract, and they are as fully a part of the Contract as if hereto attached or herein repeated. The following is an enumeration of the Specifications and drawings.

SPECIFICATIONS:

ADDENDA:

DRAWINGS:

## SECTION I-E

The Owner and the Contractor hereby agree to the full performance of the covenants herein.

IN WITNESS WHEREOF the parties hereto have executed this Agreement in

________________________ the day and year first above written.

________________________

WITNESS:

________________________ BY: ________________________

(TITLE)

UNIVERSITY OF MAINE

________________________

WITNESS:

________________________ BY: ________________________

Duly Authorized (TITLE)

---

# BRIGHAM YOUNG UNIVERSITY

## PHYSICAL PLANT DEPARTMENT

### SHORT FORM CONTRACT Nº 1124

To:

(Hereinafter called "Contractor")

Brigham Young University of Provo, Utah (hereinafter called "Owner") engages the Contractor to perform and complete the following described work, on the terms and subject to the conditions hereinafter set forth (including the Contract Documents identified below):

A. **IDENTIFICATION OF CONTRACT DOCUMENTS:**

B. **COMPENSATION:**

Total compensation for the above work shall be $
which shall be paid as follows:

C. **TIME OF COMPLETION:**

The work shall be completed on or before
Time is of the essence.

D. **OWNER'S REPRESENTATIVE IS:**

E. **CONTRACTOR'S REPRESENTATIVE IS:**

The Contractor agrees to perform the work covered by this Contract and to comply with and be bound by all of the terms and conditions contained in the Contract Documents.

BRIGHAM YOUNG UNIVERSITY DATE CONTRACTOR DATE

THE CHURCH OF JESUS CHRIST
OF LATTER-DAY SAINTS
CHURCH EDUCATIONAL SYSTEM
CONTRACT

## CONSTRUCTION CONTRACT

THIS AGREEMENT, made and entered into this ____________ day of ______________________, by and between ____________

______________________________________________

______________________________________________

hereinafter called "Contractor," and THE CURATORS OF THE UNIVERSITY OF MISSOURI, a public corporation of the State of Missouri, hereinafter called "Owner":

WITNESSETH: That for and in consideration of the acceptance of Contractor's bid and the award of this Contract to Contractor by Owner, and in further consideration of the agreements and undertakings of the parties hereinafter set forth, it is agreed by and between the parties hereto, as follows:

1. Contractor shall ______________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

______________________________________________

2. Contractor shall commence work under this contract

______________________________________________

______________________________________________

______________________________________________

______________________________________________

3. Contractor agrees that ____________ is fully informed regarding all of the conditions affecting the work to be done under, and as to the labor, supervision, materials, equipment, transportation, tools, and plant to be furnished for the completion of, this Contract and also agrees that ____________ information was secured by personal investigation and research and not from any estimates or representations of any officer, agent or employee of Owner.

4. For the complete performance of Contractor's undertakings and promises under this Contract, Owner shall cause to be paid to Contractor the sum of ______________________________ DOLLARS ($____________) subject to any deductions as provided in the Contract Documents.

5. The Contract price hereunder shall be payable as provided by law upon certification of the ____________ that the same is due and payable under the terms of the Contract, as follows:

(a) Monthly payments of ninety percent (90%) of the value of all labor performed at the job site and materials delivered at the job site during the preceding month, calculated in proportion to the Contract amount, and subject to the reservations and conditions provided in the Specifications forming a part of this Contract.

(b) Final payment of the balance due under this Contract upon the completion of the work herein contracted for to the satisfaction of the Owner. and acceptance thereof by Owner.

6. The Contract Documents shall consist of the following parts:

(a) This instrument,

(b) Owner's Advertisement for Bids, dated ______________,

(c) Information for Bidders, General Conditions, Scope and Instruction, the Specifications referred to in the paragraph numbered 1, above, together with Addenda Nos. ________ issued thereto, and the Form of Proposal,

(d) Contractor's Proposal dated __________ addressed to The Curators of the University of Missouri, Columbia, Missouri,

(e) Contractor's Bond for Performance and ________ payment of all subcontractors, laborers, and materialmen,

(f) Drawings.

(g) Notice to Proceed.

This instrument, together with the documents hereinabove mentioned, form the Contract, and they are as fully a part of the Contract as if attached hereto or herein repeated. In the event that any provision in any of the component parts of this Contract conflicts with any provision of any other component parts, the provision in the component part first enumerated herein shall govern except as otherwise specifically stated.

7. No member or officer of the Board of Curators of the University of Missouri incurs or assumes any individual or personal liability by the execution of this Contract or by reason of the default of the Owner in the performance of any of the terms hereof. All such liability of members or officers of the Board of Curators of the University of Missouri as such is hereby released by Contractor as a condition of and consideration for the execution of this Contract.

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed, in triplicate, on the day and year first above written.

____________________________________
CONTRACTOR

THE CURATORS OF THE UNIVERSITY OF MISSOURI

ATTEST:

__________________________
Mary Robnett, Secretary

By____________________________________
[illegible]
Vice President for Business Management

OWNER

---

CONTRACT FOR

CONSTRUCTION OF

____________________________________

Project Number________________

AT

______________________________

**THIS CONTRACT, made and executed in quadruplicate original as of the ________ day of ________________, 19___, by and between BRIGHAM YOUNG UNIVERSITY, a Utah corporation of Provo, Utah (hereinafter referred to as "Owner"), and ____________________________, a __________________ corporation, of __________________, ______________________ (hereinafter referred to as "Contractor").**

**WITNESSETH:**

**That for and in consideration of the payments hereinafter specified to be paid by the Owner to the Contractor and the covenants and agreements herein contained to be kept and performed by the parties hereto, the Contractor agrees to build and construct the proposed ______________________________________ ________________ project at ____________________ in __________________, ____________________ (hereinafter referred to as the "Project"), and to furnish all labor, supervision, equipment, transportation and power, to furnish and deliver all materials, and perform and supervise all work as required herein and by the contract documents hereinafter identified, all of which shall collectively constitute the contract, and shall hereinafter be referred to collectively as the "Contractor."**

**REVISED:
September 1, 1974**

**THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS CHURCH EDUCATIONAL SYSTEM CONTRACT
C/1**

ARTICLE I. THE IDENTIFICATION OF CONTRACT DOCUMENTS.

A. The "plans" for the Project consist of _____ _______ drawing(s), prepared by __________________, Architect, and approved on __________, 19__ which plans are identified as follows:

B. The "specifications" for the Project as prepared by _______________ Architect, and approved on _______________, 19___.

C. Addenda ____________________________________________________

ARTICLE II. DATE OF COMPLETION.

The Contractor agrees to complete the work required by the Contract on or before midnight _____________, 19___. Time is hereby expressly declared to be of the essence of the Contract.

ARTICLE III. THE CONTRACT SUM.

The Owner agrees to pay to the Contractor, in accordance with the terms hereof, a total of $__________________, which sum the Contractor agrees to accept as full compensation for performing his obligations under the Contract.

ARTICLE IV. THE CONTRACTOR'S REPRESENTATIVE.

The Contractor's Representative is ________________________________.

ARTICLE V. THE OWNER'S REPRESENTATIVE.

The Owner's Representative is ________________________________.

IN WITNESS WHEREOF, each of the parties hereto has caused this instrument to be signed by its President, attested by its Secretary, and its corporate seal to be hereunto affixed, all as of the day and year first above written.

---

ATTEST:

BRIGHAM YOUNG UNIVERSITY
a Utah corporation

______________________________
Secretary

By______________________________
President

OWNER

ATTEST:

(Name of Organization in all caps)
a ____(State)____ corporation,

______________________________
Secretary

By______________________________
President

CONTRACTOR

ACKNOWLEDGED:

______________________________
Director, Department of Physical Plant

______________________________
Church Building Division

______________________________
Office, Commissioner of Education

The following statement, or something similar, is required on many projects:

## CERTIFICATION OF NONSEGREGATED FACILITIES

The contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The contractor certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause of this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. The contractor agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontractors exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such certifications in his files.

CONTRACTOR: ______________________________

BY: ______________________________

---

SOUTHERN ILLINOIS UNIVERSITY

## BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That we, ______________________________

______________________________ (hereinafter called the "Principal"),

as Principal, and the ______________________________

______________________________, of ______________________________,

a corporation duly organized under the laws of the State of ______________________________,

(Hereinafter called the "Surety"), as Surety, are held and firmly bound unto THE BOARD OF TRUSTEES of SOUTHERN ILLINOIS UNIVERSITY, CARBONDALE, ILLINOIS (Hereinafter called the "Obligee"), in the sum of ______________________________ Dollars ($ ), for the payment of which sum well and truly to be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents. The condition of this obligation is such, that

WHEREAS, the Principal has submitted a bid for ______________________________

______________________________

______________________________

______________________________

NOW, THEREFORE, if the Obligee shall accept the bid of the Principal and the Principal shall enter into a formal contract with the Obligee in accordance with the terms of such bid and give such bond or bonds as may be specified in the bidding or contract documents with good and sufficient surety qualified in accordance with the requirements of the bidding or contract documents, which bond or bonds shall assure the faithful performance of such contract and the prompt payment for labor and material furnished in the prosecution thereof, or in the event of the failure of the Principal to enter such contract and give such bond or bonds, if the Principal shall pay to the Obligee the difference not to exceed the penalty hereof between the amount specified in said bid and such larger amount for which the Obligee may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect.

Signed and sealed this ______________ day of ______________ A.D. 197____.

______________________________ (Seal)
(Principal)

______________________________

______________________________
(Title)

______________________________ (Seal)
(Surety)

______________________________

______________________________
(Title)

1-08333-3

## CONTRACTOR'S COMBINATION BID BOND
## AND BOND FOR CONSTRUCTION

KNOW ALL MEN BY THESE PRESENTS, that ______________________________ (hereinafter called the "Principal"), as Principal, and ________________ of ______________________, a corporation duly organized under the laws of the State of ______________, and duly admitted to transact business in the State of Indiana, (Hereinafter called the "Surety"), as Surety, and held and firmly bound unto the Trustees of Purdue University in the penal sum of ____________________Dollars ($____________) for the payment of which, well and truly to be made, we, the said Principal and the said Surety, bind ourselves, jointly and severally, and our joint and several heirs, personal representatives successors and assigns, firmly by these presents, this _____ day of ______________, 1972.

THE CONDITIONS OF THE ABOVE OBLIGATION ARE SUCH, That, WHEREAS, the Principal has submitted a bid for the purposes to enter into a contract with the Trustees of Purdue University for the ______________________________________

______________________________________________________

______________________________________________________

situated on or near the Purdue University, North Central Campus, in Westville, Indiana, pursuant to and in accordance with the plans and specifications therefore prepared by __________________, __________________, Architects, which said bid, proposed contract, plans and specifications are hereby made a part of this Bond: NOW, THEREFORE, if the Principal shall complete and furnish to the Trustees of Purdue University a Subcontractor and Material Questionnaire in the form and manner and within the time required by the Instructions to Bidders, and if the Trustees of Purdue University shall award said contract to the Principal and the Principal shall promptly enter into and execute a written contract with the Trustees of Purdue University for said work in accordance with said plans and specifications and shall well and truly keep, do and perform said contract and all terms, conditions and provisions thereof, and all matters and things in said contract set forth and specified to be by said principal, kept, done and performed, at the times and according to the manner specified in said contract and in accordance with all requirements of law, including, without limiting the generality of the foregoing, the full, complete and timely payment by said principal of all indebtedness which may accrue to any person, firm or corporation on account of any labor or service performed or rendered or materials furnished in connection with or arising out of the performance of said contract, or shall pay over, make good and reimburse to the Trustees of Purdue University loss and damage which it may sustain by reason of any failure or default on the part of said Principal so to do, then this obligation shall be null and void, otherwise to remain in full force and effect.

This Bond shall inure directly to the benefit of all sub-contractors, laborers, materialmen and those performing services and who may have furnished or supplied labor or material for and on account of the work called for by said contract.

No change, modification, omission or addition in and to the terms, conditions and provisions of said contract (whether before or after the execution thereof) or of said plans or specifications, or of any other documents constituting a part of said contract or of said plans and specification, or any irregularities or defect in said contract or in the lettering, awarding, or execution of said contract or in any of the proceedings preliminary thereto shall in any wise affect or operate to release or discharge the Surety, whether or not the Surety has notice thereof.

IN WITNESS THEREOF, we have hereunto set our hands and seals this __________

day of ____________________, 1972.

| | |
|---|---|
| SURETY | PRINCIPAL |
| ____________________ | ______________________________ |
| ____________________ | ______________________________ |

---

## PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That ______________________________

____________, of ______________ as Principal, hereinafter called Contractor, and ____________________________, as Surety, hereinafter called Surety, are held and firmly bound unto ________________________, as Obligee, hereinafter called Owner, in the amount of ________________

______________________ ($________________), for the payment whereof Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Contractor has by written agreement dated ____________________, entered into a contract with Owner for ______________________________

______________________________ in accordance with drawings and specifications prepared by ______________________, Architect, which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS such that, if Contractor shall promptly and faithfully perform said contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

The Surety hereby waives notice of any alteration of extension of time made by the Owner.

Whenever Contractor shall be, and declared by Owner to be in default under the Contract, the Owner having performed Owner's obligations thereunder, the Surety may promptly remedy the default, or shall promptly:

1. Complete the Contract in accordance with its terms and conditions, or

2. Obtain a bid or bids for submission to Owner for completing the Contract in accordance with its terms and conditions, and upon determination by Owner and Surety of the lowest responsible bidder, arrange for a contract between such bidder and Owner, and make available as work progresses (even though there should be a default or a succession of defaults under the contract or contracts of completion arranged under this paragraph) sufficient funds to pay the cost of completion less the balance of the contract price; but not exceeding, including other costs and damages for which the Surety may be liable hereunder, the amount set forth in the first paragraph hereof. The term "balance of the contract price," as used in this paragraph, shall mean the total amount payable by Owner to Contractor under the Contract and any amendments thereto, less the amount properly paid by Owner to Contractor.

Any suit under this bond must be instituted before the expiration of two (2) years from the date on which final payment under the contract falls due.

No right of action shall accrue on this bond to or for the use of any person or corporation other than the Owner named herein or the heirs, executors, administrators or successors of Owner.

Signed and sealed this ______ day of ____________________ A.D., 197____.

IN THE PRESENCE OF:

______________________ ___________________________________(Seal)
Principal

___________________________________
Title

______________________ ___________________________________(Seal)
Principal

___________________________________
Title

STATE OF ____________________)
) SS
COUNTY OF ___________________)

___________________________________, being first duly sworn an oath, deposes and says, that he is the ________________ of said Surety Company, and that he is duly authorized to execute and deliver the foregoing obligation; that said Surety Company is authorized to execute the same and has complied in all respects with the laws of ____________________ in reference to becoming sole Surety upon bonds, undertakings and obligations.

___________________________________

Subscribed and sworn to before me this ______ day of ________________ 197____.

___________________________________
Notary Public

My Commission expires:

__________________________

THE CHURCH OF JESUS CHRIST OF LATTER-DAY
SAINTS CHURCH EDUCATIONAL SYSTEM

---

BOARD OF TRUSTEES
SOUTHERN ILLINOIS UNIVERSITY

## INDEMNITY BOND

THIS INSTRUMENT WITNESSETH, That we ________________________________

as Principal of ______________________________ State of ______________________

and ________________________________________________, a corporation organized and existing under a

virtue of the laws of the State of ______________________________________ and legally authorized to do business i

State of Illinois, as Surety are held and firmly bound unto the Board of Trustees, Southern Illinois University, in the penal sum of ________

______________________________________________________($

lawful money of the United States, well and truly to be paid unto said Board of Trustees, Southern Illinois University for the payment of we bind ourselves, our successors and assigns, jointly, severally and firmly by these presents.

Sealed with our seals and dated this ______________ day of ______________________ A. D. 19______.

THE CONDITION OF THE FOREGOING OBLIGATION IS SUCH, That, whereas, the said Principal has entered into a written co

with the Board of Trustees, Southern Illinois University for the performance of work designated as ______________________

______________________________________________________________________

located at ______________________________________________________________

in the State of Illinois, in conformity with the drawings, general conditions and specifications furnished by Southern Illinois University, contract, drawings, general conditions and specifications are hereby referred to, and made a part thereof the same to all intents and purpo if written at length herein in which contract the said Principal has contracted to perform the work specified in said contract in accordance the terms thereof.

AND the said Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition t terms of the contract or to the work to be performed thereunder or the specifications accompanying the same shall in anywise affect its oblig on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract the work or to the specifications.

NOW, THEREFORE, if said Principal shall well and truly perform said work in accordance with the terms of said contract and the Pri or Surety shall pay all sums of money due, or to become due, for any labor, materials, apparatus, fixtures or machinery furnished for th pose of constructing the work provided in said contract and shall commence and complete the work within the time prescribed in said co and shall pay and discharge all damages, direct or indirect, that may be suffered or sustained on account of such work during the time of per ance thereof, and until said work shall have been accepted, and shall hold the people of the State of Illinois and the said Board of Tru Southern Illinois University, harmless on account of any such damages and shall in all respects fully, promptly, and faithfully comply wi provisions, conditions and requirements of said contract, then this obligation to be void; otherwise to remain in full force and effect.

This bond is executed and delivered to the obligee and accepted by it upon the express agreement and consent of the parties hereto tha amendment or amendments, or any supplement or supplements to said contract, plans and specifications, or any amendments or supplements th made by the parties to said contract shall not operate as a release in favor of said principal obligor or the Surety herein, or their respective cessors or assigns, and against said THE PEOPLE OF THE STATE OF ILLINOIS or the BOARD OF TRUSTEES, SOUTHERN ILLINOIS VERSITY, but this bond shall be binding and in full force and effect as to the said contract as amended or supplemented.

This bond is further conditioned for the payment to any person, firm, company or corporation to whom any money may be due fo labor, materials, apparatus, fixtures or machinery furnished for the purpose of constructing the work provided in said contract, and suit m maintained on this bond by any such person, firm, company or corporation, for the recovery of any such money.

APPROVED AS TO FORM AND EXECUTION

______________________________ ______________________________
Legal Counsel

______________________________

Approved ______________________________ ______________________________(
University Architect Principal

SOUTHERN ILLINOIS UNIVERSITY

______________________________

Accepted ______________________________ 19______

______________________________

By ______________________________
Business Manager

______________________________ (
Surety

## LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That ______________________________

______________________________, of ______________________________ as

Principal, hereinafter called Principal, and ______________________________

______________________________, as Surety, hereinafter

called Surety are held and firmly bound unto ______________________________

______________________________, as Obligee, hereinafter called Owner, for

the use and benefit of claimants as hereinbelow defined, in the amount of

______________________________ Dollars ($______________________).
for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has by written agreement dated ______________________,

entered into a contract with Owner for ______________________________

______________________________ in accordance with drawings and

specifications prepared by ______________________________
which contract is by reference made a part hereof, and is hereinafter referred to as the Contract.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is such that if the Principal shall promptly make payment to all claimants as hereinafter defined, for all labor and material used or reasonably required for use in the performance of the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions:

1. A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, material, or both, used or reasonably required for use in the performance of the contract, labor and material being construed to include that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental of equipment directly applicable to the Contract.

2. The above named Principal and surety hereby jointly and severally agree with the Owner that every claimant as herein defined, who has not been paid in full before the expiration of a period of ninety (90) days after the date on which the last of such claimant's work or labor was done or performed, or materials were furnished by such

claimant, prosecute the suit to final judgment for such sum or sums as may be justly due claimant and have execution thereon. The Owner shall not be liable for the payment of any costs or expenses of any such suit.

3. No suit or action shall be commenced hereunder by any claimant.

   a) Unless claimant, other than one having a direct contract with the Principal, shall have given written notice to any two of the following: The Principal, the Owner, or the Surety above named, within ninety (90) days after such claimant did or performed the last of the work or labor, or furnished the last of the materials for which said claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were furnished, or for whom the work or labor was done or performed. Such notice shall be served by mailing the same by registered mail or certified mail, postage prepaid, in an envelope addressed to the Principal, Owner or Surety, at any place where an office is regularly maintained for the transaction of business, or served in any manner in which legal process may be served in the state in which the aforesaid project is located, save that such service need not be made by a public officer.

   b) After the expiration of one (1) year following the date on which Principal ceased work on said contract, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof such limitation shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   c) Other than in a state court or competent jurisdiction in and for the county or other political subdivision of the state in which the project, or any part thereof, is situated or in the United States District Court for the district in which the project, or any part thereof, is situated, and not elsewhere.

4. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder, inclusive of the payment by Surety of mechanic's liens which may be filed of record against said improvement, whether or not claim for the amount of such lien by presented under and against this bond.

Signed and sealed this _________ day of _____________________ A.D., 197___.

IN THE PRESENCE OF:

_________________________ _________________________(Seal)
Principal

_________________________
Title

_________________________ _________________________(Seal)
Surety

_________________________
Title

STATE OF _____________________ )
) SS
COUNTY OF ____________________ )

_________________________________________, being first duly sworn on oath, deposes and says, that he is the _________________ of said Surety Company, and that he is duly authorized to execute and deliver the foregoing obligation; that said Surety Company is authorized to execute the same and has complied in all respects with the laws of _________________ in reference to becoming sole Surety upon bonds, undertakings and obligations.

_________________________________

Subscribed and sworn to before me this ______ day of _______________ 197___.

_________________________________
Notary Public

My Commission expires:

_________________________

THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS CHURCH EDUCATIONAL SYSTEM

---

## WAIVER OF LIEN

State of }
} SS. 19
County of }

To Whom It May Concern:

Whereas the undersigned having been employed by to furnish

for the building known as under University Contract No. by which the said

entered into an agreement with the Board of Trustees of Southern Illinois University for work to be done for them in the County of [1] , State of Illinois.

NOW, THEREFORE, KNOW YE, That , the undersigned, for and in consideration of the sum of

Dollars and other good and valuable considerations, the receipt of which is hereby acknowledged, does hereby waive and release any and all liens, or claim or right to liens on said above described building and premises under the Statutes of the State of Illinois or on account of labor or materials or both furnished to this date and does further release the said Board of Trustees of Southern Illinois University

and its surety, from any lien, claim of lien, or claim of any portion of compensation due on or account of

(SEAL)

Subscribed and sworn to before me this day of 19

Notary Public

SF-9

## CONTRACTOR'S AFFIDAVIT, WAIVER OF LIEN AND WAGE STATEMENT

________________________________

________________________________ being duly sworn, deposes and says that he makes this affidavit on behalf of ________________________________ ________________________________, Contractor, having entered into agreement with Michigan State University, for the construction of ________________________________ ________________________________________________________________ on the premises of the Owner located in Ingham County, Michigan, that all labor, material, and services committed for, have been fully paid and the indebtedness discharged to the date of this affidavit. Furthermore, for and in consideration of $________________________, paid to the Undersigned, does hereby waive, release and relinquish any and all claims or right of lien which the Undersigned may now have upon the premises above described, for labor and material, general supervision of construction or alteration, and/or otherwise.

This will also serve to certify that all persons employed at the project site during the period covered by this invoice received at least the minimum prevailing wage and fringe benefit rates prescribed in the Contract Documents.

________________________________

BY ________________________________

TITLE ________________________________

SUBSCRIBED AND SWORN TO BEFORE ME,

THIS __________ DAY OF __________,

A.D.__________. NAME ________________________

MY COMMISSION EXPIRES ________________________

---

P. P. Form 64
Rev. Nov. 1971

## PURDUE UNIVERSITY

## CONTRACTOR'S AFFIDAVIT

Date ____________________

TO WHOM IT MAY CONCERN:

We, the undersigned, ________________________________________________
Company Name Address

to furnish and/or install ________________________________ for the ________________________________ of Purdue University, do hereby affirm that
Project Name

all charges against us for labor, materials, equipment, rentals and all other items of expense under this contract to date have been paid in full, except as follows: (List all unpaid items of expenses whether invoice has been received or not.)

Also, we, the undersigned, hereby acknowledge receipt of:

________________________________________________________________ Dollars,
(Total previous payments received to date for this project)

($________________________) from Purdue University for work performed by us on this project.

Given under our hand and seal this __________ day of ________________ 19____.

________________________________
Company Name

By ________________________________

STATE OF ____________________ )
) SS
COUNTY OF ____________________ )

Subscribed and sworn to before me this __________ day of ________________ 19____.

________________________________
Notary Public

My commission expires ______________.

## PERIODICAL ESTIMATE FOR PARTIAL PAYMENT
### Washington State University

WSU Contract No.______ Periodical Estimate No.____ For Period__________ to __________, Incl.

Project __________________________________
Name City

Contractor __________________________________
Name City

| Item No. | Description of Item | Approximate % Completed | | Contract Breakdown (Not Incl. Tax) | This Estimate | Completed to Date (Incl. THIS Estimate) |
|---|---|---|---|---|---|---|
| | | Period | Total | | | |
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |
| 5. | | | | | | |
| 6. | | | | | | |
| 7. | | | | | | |
| 8. | | | | | | |
| 9. | | | | | | |
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| 33. | | | | | | |
| 34. | | | | | | |
| 35. | | | | | | |

(Do Not Include Sales Tax On Any Item Above This Line)

RECEIVED __________

THE ABOVE TOTAL PERCENTAGES OF COMPLETION ARE APPROVED.
FACILITIES PLANNING

By __________

Date __________

PAYMENT PROCESSED ON

Date __________

| | | | |
|---|---|---|---|
| Value of Contract Work (less tax) | | | |
| Change Order Additions " " | | | |
| Change Order Deductions " " | | | |
| SUBTOTAL | | | |
| Sales Tax | | | |
| TOTAL | | | |
| Less Retainage on SUBTOTAL | XXXXX | XXXXX | |
| Net amount earned to date | XXXXX | XXXXX | |
| Less previous payments | XXXXX | XXXXX | |
| Balance due this payment | XXXXX | XXXXX | |

## CHANGE ORDERS

| No. | Date | Description | Addition | | | Deduction |
|---|---|---|---|---|---|---|
| | | | Amount | This Estimate | Completed to date (including this certificate) | |
| | | TOTAL | | | | |

NOTE: Do not include tax on any of the above items or totals.

### CERTIFICATION OF THE CONTRACTOR OR HIS DULY AUTHORIZED REPRESENTATIVE

According to the best of my knowledge and belief, I certify that all items and amounts shown in this periodical estimate are correct, that all work has been performed and/or material supplied in full accordance with the terms and conditions of the contract betwee the Board of Regents of Washington State University and____________________ dated ______________, and/or subsequent approved Change Orders or other duly authorized deviations; that this is a true and correct statement of the contract account up to and including the last day of the period covered by this estimate, and that no part of the "Balance due this payment" has been received.

I CERTIFY that each laborer, workman, and mechanic employed on this project has been paid an hourly wage rate as set forth in the specifications of this project in accordance with the pre-filed Statement or Statements of Intent on file with the Washington State Department of Labor and Industries as approved by the Industrial Statistician, and that no such employee has been paid less than the prevailing rate of wage as defined in RCW 39.12.040.

I FURTHER CERTIFY that all just and lawful bills against the undersigned and his subcontractors for labor, material, and equip- ment employed in the performance of this contract have been paid or will be paid in full in accordance with the terms and conditions of said contract and that all amounts have been paid for items for which previous payments have been received.

____________________ By ____________________
Contractor Authorized Representative

____________________ 19____ ____________________
Date Title

STATE OF WASHINGTON } ss.
County of }

____________________ being first duly sworn on oath, deposes and states:

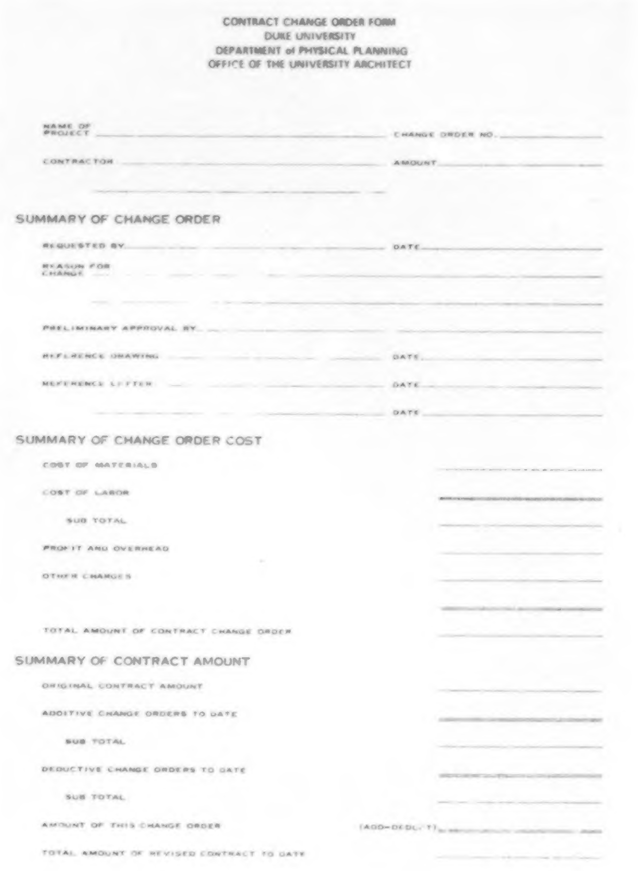
That he is the Contractor above named, that he has read the above and foregoing instrument, knows the contents thereof and the same is true as he verily believes.

SUBSCRIBED and SWORN to before me this __________ day of ______________, 19____

____________________
Notary Public in and for the State of Washington,

Residing in the City of ____________________

Fac. Plan. 466 9



CONTRACT CHANGE ORDER FORM
DUKE UNIVERSITY
DEPARTMENT of PHYSICAL PLANNING
OFFICE OF THE UNIVERSITY ARCHITECT

NAME OF PROJECT ____________ CHANGE ORDER NO. ____________

CONTRACTOR ____________ AMOUNT ____________

SUMMARY OF CHANGE ORDER

REQUESTED BY ____________ DATE ____________

REASON FOR CHANGE ____________

PRELIMINARY APPROVAL BY ____________

REFERENCE DRAWING ____________ DATE ____________

REFERENCE LETTER ____________ DATE ____________

____________ DATE ____________

SUMMARY OF CHANGE ORDER COST

COST OF MATERIALS ____________

COST OF LABOR ____________

SUB TOTAL ____________

PROFIT AND OVERHEAD ____________

OTHER CHARGES ____________

TOTAL AMOUNT OF CONTRACT CHANGE ORDER ____________

SUMMARY OF CONTRACT AMOUNT

ORIGINAL CONTRACT AMOUNT ____________

ADDITIVE CHANGE ORDERS TO DATE ____________

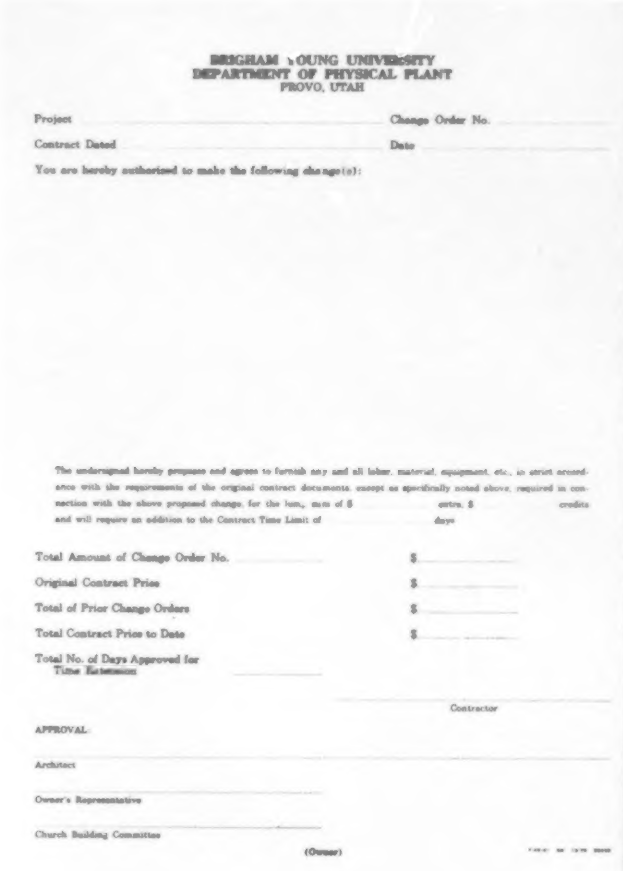
SUB TOTAL ____________

DEDUCTIVE CHANGE ORDERS TO DATE ____________

SUB TOTAL ____________

AMOUNT OF THIS CHANGE ORDER (ADD–DEDUCT) ____________

TOTAL AMOUNT OF REVISED CONTRACT TO DATE ____________



**BRIGHAM YOUNG UNIVERSITY**
**DEPARTMENT OF PHYSICAL PLANT**
PROVO, UTAH

Project ____________ Change Order No. ____________

Contract Dated ____________ Date ____________

You are hereby authorized to make the following change(s):

The undersigned hereby proposes and agrees to furnish any and all labor, material, equipment, etc., in strict accordance with the requirements of the original contract documents, except as specifically noted above, required in connection with the above proposed change, for the lump sum of $ ____________ extra, $ ____________ credits and will require an addition to the Contract Time Limit of ____________ days

Total Amount of Change Order No. ____________ $ ____________

Original Contract Price $ ____________

Total of Prior Change Orders $ ____________

Total Contract Price to Date $ ____________

Total No. of Days Approved for Time Extension ____________

____________
Contractor

APPROVAL:

____________
Architect

____________
Owner's Representative

____________
Church Building Committee
(Owner)

[illegible]

The Commonwealth of Massachusetts
UNIVERSITY OF MASSACHUSETTS
Amherst, Massachusetts

Project No. ……………
Contract No. ……………
Notice of Intent No. ……………
Date: ……………

## NOTICE OF INTENTION
## TO REQUEST A CHANGE IN CONTRACT

**A** The ______________ hereby issues notice of intention to request change(s) in the Contract Documents hereinafter specified:
*(University — Contractor — Engineer — Architect)

**PROJECT NO** ______ **CONTRACT NO.** ______ **DATE OF CONTRACT** ______

CONTRACT TITLE: ______________

CONTRACTOR: ______________

**B** **LOCATION OF PROPOSED CHANGE:**

**C** **DESCRIPTION OF REQUESTED CHANGE:** (Use reverse side of this sheet if necessary.)

**D** **REQUESTED CHANGE IN CONTRACT TIME AND COST**
(Check appropriate blocks.)

☐ Change involves no change in contract time and cost.

☐ An adjustment in contract price estimated at ______ (Words) ______ dollars ($ ______ (Figures)) to be (*added to) (*deducted from) the contract amount will be proposed.

☐ An extension in contract time of ______ days will be requested.

**E** **CONTRACT DATA:**

1. AMOUNT OF ACCEPTED BID ______ $ ______
2. TOTAL AMOUNT OF CONTRACT ______ (Including Change Order Numbers) $ ______
3. ESTIMATED CHANGE IN CONTRACT COST FOR THIS REQUEST ______ $ ______
4. ESTIMATED TOTAL COST OF CONTRACT INCLUDING THIS CHANGE REQUEST ______ $ ______
5. EXTENSION OF ______ (Number) DAYS TO BE REQUESTED

*Strike out terms which do not apply.

INITIATED BY: ______________ (Signature)
TITLE: ______________ DATE: ______
APPROVED BY: ______________ (Director of Physical Plant)

Form No. [illegible]

---

The Commonwealth of Massachusetts
UNIVERSITY OF MASSACHUSETTS
Amherst, Massachusetts

Project No. ……………
Contract No. ……………
Change Order No. ……………
Date: ……………

## CHANGE ORDER REQUEST AND AGREEMENT TO:

**PROJECT NO** ______ **CONTRACT NO** ______ **DATE OF CONTRACT** ______
CONTRACT TITLE: ______________ ORIGINAL CONTRACT
CONTRACTOR ______________ COMPLETION DATE: ______

**(All signatures below are affixed under the penalties of perjury.)**

**A** **REQUEST FOR A CHANGE:**

1. Submitted by ______ (Name of Initiator) for ______ *(University, Contractor, Engineer, Architect)
2. Received by Clerk of the Works ______ (Date) ______ (Signature of Clerk of Works)
3. Location of Proposed Change:
4. Description of Requested Change:

**B** **CONTRACTOR'S PROPOSAL:**
The undersigned proposes to perform the work described in A4 above in accordance with the provisions of the Contract Documents for:

The lump sum of ______ (Words) ______ dollars ($ ______ (Figures)) to be (*added to) (*deducted from) the contract amount.
A sum based on time and materials not to exceed ______ (Words) ______ dollars ($ ______ (Figures)) to be added to the contract amount.
An extension of time of ______ ( ______ ) calendar days is requested.

CONTRACTOR ______________
BY ______ (Signature) ______ (Title) DATE ______
Attach necessary supporting documents

**C** **APPROVAL OF ABOVE REQUEST AND PROPOSAL RECOMMENDED:**
(a) ______ (Clerk of Works) ______ (Date)
(b) ______ (Engineer) ______ (Date)
(c) ______ (Date)
(d) ______ (Date)

**D** **APPROVED AS NECESSARY TO PROVIDE A COMPLETE PROJECT SATISFACTORY TO THE UNIVERSITY:**
BY: ______ (Director of Physical Plant) ______ (Date)

**E** **APPROVED BY THE UNIVERSITY OF MASSACHUSETTS:**
(a) For the amount *requested or *corrected to $ ______
(b) Extension of Contract of ______ days.
Adjusted Contract completion date ______
BY ______ (Treasurer, University of Massachusetts) DATE ______

NOTE: Upon signature by the Treasurer of the University of Massachusetts this request becomes a formal change order for distribution.

*Strike out terms which do not apply.

**DO NOT FILL IN THIS BLOCK**

Contract Award $ ______
Previous Additions $ ______
Previous Deductions $ ______
Previous Net Total $ ______
This Change $ ______
Total To Date $ ______
P. O. # ______
Account # ______
Agency ______

Form No. [illegible]

**COMPTROLLER'S OFFICE COPY**

WASHINGTON STATE UNIVERSITY
**Department of Facilities Planning**
Pullman, Washington

# DIARY-INSPECTION REPORT

JOB NAME: ____________ JOB NO.: ________ DATE: ____

WEATHER: ____________ HIGH: ______ LOW: ______ HOURS ON SITE:

| | | | | | | |
|---|---|---|---|---|---|---|
| MEN AT WORK: | | * | | | * | |
| Superintendent | | | Structural Steel | | | Terrazzo and Tile |
| Foremen | | | Re-Bar | | | Acoustical Tile |
| Carpentry | | | Masonry | | | Painting |
| Labor | | | Roof and Sheetmetal | | | Plumbing |
| Concrete Finish | | | Lath and Plaster | | | Heating & Ventilating |
| Earth Work | | | Sash and Glazing | | | Electrical |
| | | | | | | |
| | | | | | | |

PROGRESS, INSTRUCTIONS, AND QUESTIONS:

* Payrolls received and checked

COPIES TO: Facilities Planning INSPECTOR: ____________

---

THE CHURCH OF JESUS CHRIST OF LATTER DAY SAINTS
Church Educational System
Brigham Young University
Provo, Utah
Department of Physical Plant

## MONTHLY PROGRESS ESTIMATE

Date

Estimate No.

Period From To

Payable to
(Name & address
of Contractor)

Project Name

Project No.

Contract Date

| ITEM NO. | DESCRIPTION | UNITS | ITEM TO TOTAL | CONTRACT BID PRICE | THIS ESTIMATE | AMOUNT THIS ESTIMATE | TO DATE | AMOUNT TO DATE |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | Amount Allowed to Date | | | | | | | |
| | Amount Allowed for Material on Hand | | | | | | | |
| | Gross Amount Allowed to Date | | | | | | | |
| | Less Retained Reserve | | | | | | | |
| | Less Other Deductions | | | | | | | |
| | Net Amount Allowed to Date | | | | | | | |
| | Less Previous Payments | | | | | | | |
| | Net Payment This Estimate | | | | | | | |

Approved

Contractor

Owner's Representative

December 1, 1972

OWNER'S COPY
FINAL SUBMITTAL

## SHOP DRAWING TRANSMITTAL

Architect: ______________________ Contractor: ______________________

Street: ______________________ Street: ______________________

City: ______________________ City: ______________________

Project: ______________________ Subcontractor: ______________________

Ricks Project No. ______________________ Street: ______________________

Architect Design No.: ______________________ City: ______________________

Submitted herewith for approval are itemized drawings covering one trade and/or one subcontractor only.

| DWG. NO. | DESCRIPTION AND PURPOSE |
|---|---|
| | |

| OZALID OR BROCHURE SUBMITTAL | COPIES | DATE |
|---|---|---|
| To Architect (From Contractor) | | |
| To Contractor (From Architect) | | |
| To Subcontractor (From Contractor) | | |
| | | |

| PRINT OR BROCHURE SUBMITTAL | SECOND | | FIRST | |
|---|---|---|---|---|
| | COPIES | DATE | COPIES | DATE |
| To Contractor (From Subcontractor) | | | | |
| To Owner (From Contractor) | | | | |
| To Architect (From Contractor) | | | | |
| | | | | |

Refer to drawings for indication of action taken by architect.

Contractor's Signature ______________________ Date ____________

Architect's Signature ______________________ Date ____________

Approval ____________ Disapproval ______________________ Date ____________

Remarks: ______________________

Transmittal No. ____________

---

Southern Illinois
University

CARBONDALE, ILLINOIS

*Office of the Associate University Architect*

______________________
Date

TO

SUBJECT Substantial Completion Acceptance of Project

The work performed under University Contract No ____________ has been inspected and found to be substantially complete effective as of ______________________

**Definition of Substantial Completion:**

> "The date of substantial completion of a structure or building or project is the date when the construction is sufficiently completed, in accordance with contract documents, and as modified by completed change orders, so that the Owner can occupy the building or use the structure for the use for which it is intended."

Final acceptance of the work and final payment for it will be made after completion of the deficiencies and administrative items shown on the attached Inspection Check List dated ______________________ This list may not be exhaustive and failure to include an item or the appearance of an item due to other operations of a Contractor after this acceptance does not alter the responsibility of the Contractor to complete all of the work in accordance with the contract documents, including the change orders and agreed modifications.

The Owner will assume full possession of the facility on ______________________. All responsibility of the Contractor for heating, utilities, and insurance other than liability and workman's compensation shall cease at that time.

ASSOCIATE UNIVERSITY ARCHITECT

By ______________________

cc Business Manager
Associate Architect Engineer
Director of Business Affairs
Associate University Architect
Physical Plant Director
Coordinator of Housing
H.H.F.A.
Architectural Superintendent
Director of Auxiliary Enterprises

SPD - 01

## FINAL ACCEPTANCE

Date:

Michigan State University
Physical Plant Division
Engineering Services Department
East Lansing, Michigan 48824

Re: (Name of Project)
(Number of Project)

Dear Sir:

The construction of (Name of Project) for which we are the (type of contractor) has been completed in accordance with the Contract Documents of the Architect (Name of Architect).

We have thoroughly gone over the project with the Architect and the representatives of the University, and all items have been completed to their satisfaction.

Very truly yours,

(Signature)
(Name and Address of Contractor)

Owner's Representatives

We inspected this project and it has been completed satisfactorily. It complies with the intent of the Contract Documents.

(Signature)
(Name of Architect)
(Date of Acceptance)

(Signature)
(Name of Inspector)
(Date of Acceptance)

(Signature)
(Name of Engineer)
(Date of Acceptance)

---

FOREMAN COPY

FOREMAN

ASS'T FOREMAN

**BRIGHAM YOUNG UNIVERSITY**
**Dept. of Physical Plant** W.O. **Nº 12317**

## WORK ORDER

**Charge No.** ____________

**Date Issued** ____________, 19____ **M & O** AUX CPO

**Rush Job** ☐

**Sec** ____________ **Dept.** ____________ **Bldg.** ____________ **Room** ____________

**Work To Be Done:**

**Work Completed: Date** ____________, 19

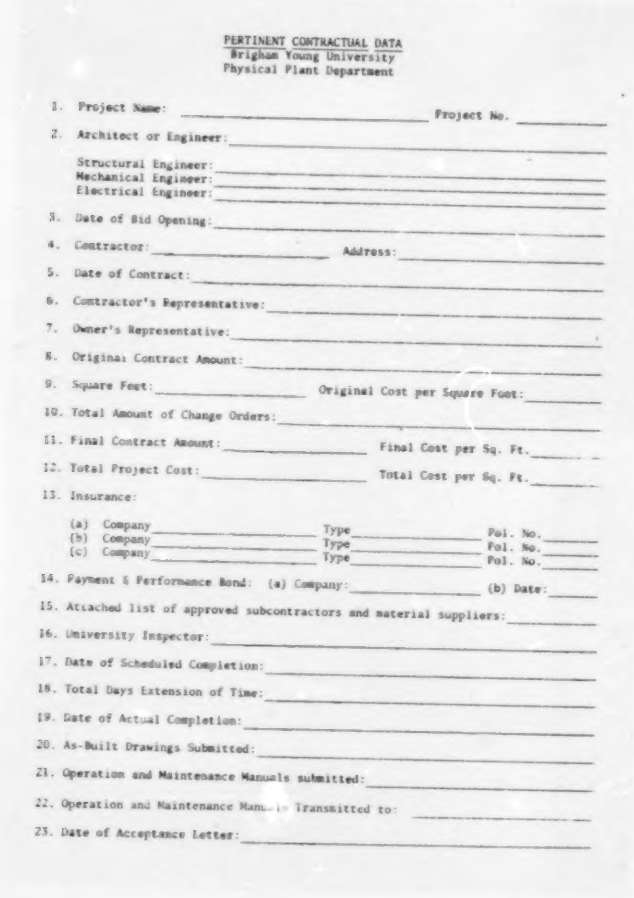
| | |
|---|---|
| Labor | $ ____________ |
| Materials | $ ____________ |
| Equip. Rental | $ ____________ |
| Admin. | $ ____________ |
| Total Cost | $ ____________ |

**Approved** ____________
Chief Clerk

**Approved** ____________
Director, Dept. of Physical Plant

**Signed** ____________
Foreman

**Noted** ____________
Superior



### PERTINENT CONTRACTUAL DATA

Brigham Young University
Physical Plant Department

1. Project Name: ____________________ Project No. ________
2. Architect or Engineer: ____________________

   Structural Engineer: ____________________
   Mechanical Engineer: ____________________
   Electrical Engineer: ____________________
3. Date of Bid Opening: ____________________
4. Contractor: ____________ Address: ____________
5. Date of Contract: ____________________
6. Contractor's Representative: ____________________
7. Owner's Representative: ____________________
8. Original Contract Amount: ____________________
9. Square Feet: ____________ Original Cost per Square Foot: ________
10. Total Amount of Change Orders: ____________________
11. Final Contract Amount: ____________ Final Cost per Sq. Ft. ________
12. Total Project Cost: ____________ Total Cost per Sq. Ft. ________
13. Insurance:

    (a) Company ____________ Type ____________ Pol. No. ______
    (b) Company ____________ Type ____________ Pol. No. ______
    (c) Company ____________ Type ____________ Pol. No. ______
14. Payment & Performance Bond: (a) Company: ____________ (b) Date: ______
15. Attached list of approved subcontractors and material suppliers: ________
16. University Inspector: ____________________
17. Date of Scheduled Completion: ____________________
18. Total Days Extension of Time: ____________________
19. Date of Actual Completion: ____________________
20. As-Built Drawings Submitted: ____________________
21. Operation and Maintenance Manuals submitted: ____________________
22. Operation and Maintenance Manuals Transmitted to: ____________________
23. Date of Acceptance Letter: ____________________

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